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INVERTEBRATE FAUNA OF THE INTERTIDAL ZONE OF THE TOKARA ISLANDS

VIII. MOLLUSCAN SHELLS[1)2)]

KATURA ÔYAMA, TORAO YAMAMOTO and TAKASI TOKIOKA

Molluscan shells of the following list were identified by the first two authors. The specimens, about 500 in all, were collected by the last author and composed of shells of living animals and empty shells stranded along the beach or picked up from the tips by the dwellings of the inhabitants of the islands. Names of molluscs found in the memorandums by the last author on the fauna of the Islands were also included in the list and marked by the abbreviation "mem." instead of the specimen number.

There still remain 115 specimens which could not be identified by the present authors and were submitted for further examination to Dr. T. KURODA and Mr. T. HABE, to whom we wish to express here our hearty thanks for their kindness in identifying some of the specimens listed below.

LIST OF THE SPECIES IDENTIFIED

GASTROPODA	Takarazima	Nakanosima
Fissurellidae		
1. *Emarginula variegata* A. ADAMS (ススイロスソキレガイ)	TK. No. 435	
2. *Scutus emarginatus* (PHILIPPI) (リユウキユウオトメガサ)	436	
3. *Clypidina* (*Montfortula*) *pulchra* (A. ADAMS) (ス ソ カ ケ ガ イ)	437	
4. *Diodora mus* (REEVE) (アサテンガイ)	444	
Patellidae		
5. *Patella* (*Penepatella*) *optima* PILSBRY (オ オ ツ タ ノ ハ)	441	442*
6. *Cellana toreuma* (REEVE) (ヨ メ ガ カ サ)		438, 439*
7. *Cellana eucosmia* (PILSBRY) (ベ ツ コ ウ ザ ラ)		440

1) Scientific Survey of the Tokara Islands, Report No. 10.
2) Contributions from the Seto Marine Biological Laboratory, No. 234.
* Also found in Suwanosezima (mem.).

	Takarazima	Nakanosima
8. *Cellana nigrisquamata* (REEVE) カサガイ		*
Lottiidae		
9. *Patelloida* sp. キクコザラ	443	
Trochidae		
10. *Alcyna ocellata* A. ADAMS キバベニバイ	446	
11. *Monodonta neritoides* (PHILIPPI) クロズケガイ		447
12. *Clanculus stigmatarius* A. ADAMS ベニフナツモモ	448	
13. *Trochus maculatus* LINNÉ ニシキウズ	449, 450	mem.
14. ?*Tectus* (*Pyramidea*) *maximus* (PHILIPPI) サラサバイ	mem.	
Turbinidae		
15. *Liotina peroni* (KIENER) リユウキユウヒメカタベ	451	
16. *Liotina* (*Dentarene*) *cycloma* (TOMLIN) ハグルマヒメカタベ	452	
17. *Collonista granulosa* (PEASE) コダマサンショウスガイ	453	
18. *Turbo* (*Olearia*) *marmoratus* LINNÉ ヤコウガイ	454–458	mem. *
19. *Turbo* (*Marmarostoma*) *setosus* GMELIN マルサザエ	459, 460	461
20. *Turbo* (*Marmarostoma*) *argyrostomus* LINNÉ チヨウセンサザエ	462	463
Neritidae		
21. *Nerita* (*undata*) *striata* BURROW コシタカアマガイ	316	317
22. *Nerita* (*Ritena*) *helicinoides laevilabris* PILSBRY イシダタミアマガイ	318	
23. *Nerita* (*Ritena*) *plicata* LINNÉ キバアマガイ	319	320
24. *Nerita* (*Ritena*) *costata* GMELIN フトスジアマガイ	321	322
25. *Nerita* (*Ritena*) *reticulata* KARSTEN クチベニアマオブネ		323
26. *Nerita* (*Theliostyla*) *albicilla* LINNÉ アマオブネ	324	325
27. *Nerita* (*Amphinerita*) *polita* LINNÉ ニシキアマオブネ	326	327–330
28. *Nerita* (*Amphinerita*) *insculpta* RÉCLUZ リユウキユウアマガイ		331
Cyclophoridae		
29. *Cyclophorus turgidus* (PHEIFFER) オキナワヤマタニシ	464	
Littorinidae		
30. *Tectarius* (*Nodilittorina*) *granularis* (GRAY) アラレタマキビ		332

	Takarazima	Nakanosima
31. *Tectarius* (*Nodilittorina*) *pictus* (PHILIPPI) タイワンタマキビ		333
32. *Tectarius* (*Nodilittorina*) *vilis* (MENKE) イボタマキビ	344	345
33. *Littorinopsis scabra* (LINNÉ) ウズラタマキビ		334
34. *Littorinopsis undulata* (GRAY) ホソスジウズラタマキビ	335	336–340
35. *Littorinopsis pintado* (WOOD) コウダカタマキビ	342	343
36. *Littorinopsis obesa* (SOWERBY) テリタマキビ	341	
Rissoidae		
37. *Rissoina* (*Phosinella*) *cerithiiformis* DUNKER キンスジチヨウジガイ	346	
38. *Rissoina subfirmata* BOETTGER フトスジチヨウジガイ	347	
Assimineidae		
39. *Paludinella stricta* GOULD ウスイロヘソカドガイ		348
40. *Angustassiminea castanea satumana* HABE サツマクリイロカワザンショウ	349	
Vermiculariidae		
41. *Vermetus gordialis* MÖRCH リユウキユウムカデ		351
42. *Spiroglyphus* sp. ミジンムカデ		352
43. *Lemintina* sp. ヘビカイの1種		353
44. *Bivonia dragonella* KURODA MS. タツノコヘビガイ		354
Thiaridae		
45. *Semisulcospira libertina* (GOULD) カワニナ		355
Planaxidae		
46. *Planaxis* (*Angiola*) *virgatus* SMITH ヨコスジタマキビモドキ	356	357
Cerithiidae		
47. *Bittium* (*Plesiotrochus*) *oosimense* (WATSON) オオシマチグサカニモリ	358	359
48. *Cerithium* (*Ochetoclava*) *sinense* (GMELIN) トウガタカニモリ	360	
49. *Contumax echinatus* (LAMARCK) メオニノツノガイ	361	
50. *Semivertagus nesioticus* (PILSBRY & VANATTA) クリムシカニモリ		362
51. *Semivertagus zebra* (KIENER) ハナカニモリ		363
52. *Semivertagus stigmosus* (GOULD) クリフカニモリ	364	
53. *Conocerithium atromarginatum* (DESHAYES) コンシボリツノブエ	365	366

	Takarazima	Nakanosima
Triphoridae		
54. *Triphora lamberti* (HERVIER) ミケイロハラブトキリオレ	367	
55. *Triphora* sp.	368	
Epitoniidae		
56. *Gyroscala perplexa* (PEASE) ネジガイ	228	
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Janthinidae		
58. *Janthina janthina* (LINNÉ) コシダカアサガオガイ	mem.	
59. *Janthina balteata* REEVE アサガオガイ	230	231
60. *Janthina* (*Violetta*) *globosa* BLAINVILLE ルリガイ	232	mem.
61. *Janthina* (*Iodina*) *umbilicata* d'ORBIGNY ヒメルリガイ	233	mem.
62. *Recluzia montrouzieri* BRAZIER	234	
Naticidae		
63. *Polinices* (*Gloussaulax*) *didyma* (RÖDING) ツメタガイ	mem.	
64. *Natica* (*Naticarius*) *concinna* DUNKER フロガイダマシ	475	
65. *Natica* (*Notocochlis*) *picta* RÉCLUZ カザリダマ		476
66. ?*Natica* (*Notocochlis*) *sagittata* MENKE ハギノツユ	477	
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Merriidae		
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69. *Merria gueriniana* (RÉCLUZ) イトカケシロネズミガイ	466	467
Amaltheidae		
70. *Amalthea* (*Antisabia*) *foliacea* (QUOY & GAIMARD)	468	469
71. *Pilosabia pirosa* (DESHAYES) スズメガイ	470	471
Calyptraeidae		
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Strombidae		
73. *Strombus* (*Conomurex*) *luhuanus* LINNÉ マガキガイ	mem.	
74. *Strombus* (*Canarium*) *urceus* LINNÉ ムカシタモト	473	474

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75. *Strombus* (*Aliger*) *latissimus* LINNÉ ゴホウラ	mem.	
76. *Lambis lambis* (LINNÉ) クモガイ	mem.	
77. *Lambis* (*Harpago*) *chiragra* (LINNÉ) スイジガイ	mem.	mem.
Eratoidae		
78. *Erato* (*Eratoena*) *sulcifera nana* (SOWERBY) ザクロモドキ	206	
79. *Trivirostra edgari* (SHAW) ハダカムギガイ	207	mem.
Amphiperatidae		
80. *Pedicularia pacifica* PEASE	445	
81. *Calpurnus* (*Procalpurnus*) *lacteus* (LAMARCK) マメウサギガイ		208
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Cypraeidae		
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Rapidae		
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	Takarazima	Nakanosima
Pyramidellidae		
199. *Otopleura glans* (REEVE) スソグロクチキレ	235	
200. *Miralda gemma* (A. ADAMS) ホソアラレグチキレ		236
Atyidae		
201. *Atys* (*Aliculastrum*) *cylindrica* (HELBLING) カイコガイ	412	
202. *Haloa binotata* (PILSBRY) ニクイロブドウガイ	413	
Cavolinidae		
203. *Diacria trispinosa* (BLAINVILLE) ヒラカメガイ	414	
204. *Cavolinia uncinata* (RANG) クリイロカメガイ	415	
205. *Cavolinia globulosa* (RANG) マルカメガイ	416	
Ellobiidae		
206. *Laemodonta hirsuta* (GARRETT) マキスジコミミガイ	417	
207. *Melampus caffer* (KÜSTER) ハマシイノミガイ	418	419
Siphonariidae		
208. *Siphonaria laciniosa* (LINNÉ) コウダカカラマツ	420	421
209. *Siphonaria rucuana* PILSBRY コビトカラマツガイ	422, 423	
210. *Siphonaria atra* QUOY & GAIMARD ヒラカラマツガイ		424
211. *Siphonaria subatra* PILSBRY クロカラマツ	426	425
Lymnaeidae		
212. *Lymnaea* sp.		mem.
Onchidiidae		
213. *Onchidium verruculatum* CUVIER イソアワモチ	427, 428	mem.
Clausiliidae		
214. *Zaptyx* (*Metazaptyx*) *tokarana* (PILSBRY) トカラノミキセル		429
Bradybaenidae		
215. *Bradybaena phaeogramma* (ANCEY) タメトモマイマイ	430	431
216. *Bradybaena* (*Acusta*) *despecta* (SOWERBY) オキナワウスカワマイマイ	432	
217. *Satsuma oshimae* (PILSBRY) オオシママイマイ	433	
218. *Euhadra pachya* (PILSBRY) クロマイマイ	434	

PELECYPODA	Takarazima	Nakanosima
Arcidae		
219. *Arca avellana* LAMARCK ククリネジアサリ	92, 93	94
220. *Barbatia bicororata* (DILLWYN) ベニエガイ	95	
221. *Barbatia lima* (REEVE) [illegible]	96	97
222. *Acar plicata* (DILLWYN) [illegible]	98	
Mytilidae		
223. *Volsella plumescens* (DUNKER) リユウキユウヒバリガイ	99	100
224. *Brachidontes* (*Hormomya*) *mutabilis* (GOULD) ヒバリガイモドキ	101	
225. *Septifer bilocularis* (LINNÉ) [illegible]	102	
226. *Septifer excisus* (WIEGMANN) シロインコガイ	103	104, 105
227. *Lithophaga* (*Doliolabis*) *lithura* PILSBRY [illegible]	106	
Isognomonidae		
228. *Isognomon marsupialis* (RÖDING) カイシアオリ	107–110, 113	111, 112, 114
229. *Isognomon acutirostris* (DUNKER) [illegible]	115	116, 166
Pteriidae		
230. *Pinctada panasesae* (JAMESON) ミドンアメリガイ	117	
Pinnidae		
231. *Pinna* (*Quantulopinna*) *muricata* LINNÉ イワカワハゴロモガイ	118	
Pectinidae		
232. *Plicatula horrida* DUNKER イシガキモドキ	139	
233. *Chlamys* (*Gloripallium*) *pallium* (LINNÉ) チサラガイ	119	
234. *Chlamys* (*Chlamys*) *schmeltzii* (KOBELT) ヤガスリヒヨク	120	
235. *Spondylus squamosus* SCHREIBERS メンガイ		121
236. *Spondylus sanguineus* DUNKER テイロメンガイ		122
Ostreidae		
237. *Gryphaea* (*Saxostrea*) *mordax* GOULD オハグロガキ	123–129	130, 131
Trapeziidae		
238. *Trapezium oblongum* (LINNÉ) スエヒロフナガタガイ	158	

	Takarazima	Nakanosima
Codakiidae		
239. *Codakia paytenorum* (IREDALE) ウラキツキガイ	159	160
240. *Codakia delicatula* (PILSBRY) ウミアサ	161	162
Erycinidae		
241. *Kellia cycladiformis* (DESHAYES) チチノレタタリ	164	
Chamidae		
242. *Chama iostoma* CONRAD カネツケザル	132–134	135, 136
243. *Chama brassica* REEVE (var.) シロザル	137	138
244. *Chama* (*Pseudochama*) *retroversa* LISCHKE サルノカシラ		163
Tridacnidae		
245. *Tridacna* (*Vulgodacna*) *maxima* (RÖDING) オオシラナミ	140	141
246. *Tridacna* (*Chametrachea*) *crocea* (LAMARCK) ヒメジャコ	142	
Veneridae		
247. *Gafrarium dispar* (DILLWYN) ヒメイナミガイ		143
248. *Gafrarium pectinatum* (LINNÉ) ホソスジイナミガイ	144	
249. *Meretrix meretrix lusoria* (RÖDING) ハマグリ	145	
250. *Venus* (*Periglypta*) *reticulata* LINNÉ アラヌノメ	146, 147	148
Asaphidae		
251. *Asaphis dichotoma* (ANTON) リユウキユウマスホウ	149–151	152
Semelidae		
252. *Semele carnicolor* (HANLEY) サメザラモドキ	153	157
Tellinidae		
253. *Cyclotellina* (*Scutarcopagia*) *scobinata* (LINNÉ) サメザラ	154, 155	156
254. *Fabulina* (*Jactellina*) *obliquestriata* (SOWERBY) ゴシキザクラ	165	
CEPHALOPODA		
Nautilidae		
255. *Nautilus pompilius* LINNÉ オオムガイ	482	
Argonautidae		
256. *Argonauta hians* SOLANDER タコブネ	481	

General Remarks on the Molluscan Fauna

From the last author's observations on the islands and from an examination of the present material, some of the following features seem to be accepted safely as hints of the characteristics of the molluscan fauna of these islands.

1. Common shells in Takarazima and Nakanosima.

Pelecypoda: *Asaphis dichotoma* (Anton) is the commonest species in both islands, next is *Venus* (*Periglypta*) *reticulata* Linné. *Cyclotellina* (*Scutarcopagia*) *scobinata* (L.) is common in Takarazima, but rather rare in Nakanosima.

Neritidae: *Nerita* (*undata*) *striata* Burrow, *Nerita* (*Ritena*) *plicata* L. and *Nerita* (*Theliostyla*) *albicilla* L. are met with frequently in both Takarazima and Nakanosima. *Nerita* (*Ritena*) *helicinoides laevilabris* Pilsbry was common in Takarazima, but not found at all in Nakanosima where *Nerita* (*Amphinerita*) *insculpta* Récluz was found rather commonly. *Nerita* (*Amphinerita*) *polita* L. is more abundant in Nakanosima than in Takarazima. *Nerita* (*Ritena*) *costata* Gmelin is very rare in both islands.

Littorinidae: The littorinid fauna in both islands mostly consist of *Tectarius* (*Nodilittorina*) *vilis* (Menke). In Nakanosima, a considerable number of *Tectarius* (*Nodilittorina*) *granularis* (Gray) and *Littorinopsis undulata* (Gray) were found in the littorinid zone, while in Takarazima the last author found only 3 shells of the former and 2 of the latter, which are less than 7 mm in height against 13 mm in individuals from Nakanosima. *Littorinopsis obesa* (Sowerby) was found sparsely in Takarazima. *Tectarius* (*Nodilittorina*) *pictus* (Philippi), *Littorinopsis pintado* (Wood) and *Littorinopsis scabra* (L.) were all very rare. Generally speaking the littorinid fauna is very simple in Takarazima, this is probably due to poor flow of the fresh water and the regular outline of the island.

Cypraeidae: *Mauritia* (*Mauritia*) *mauritiana calxequina* (Melvill & Standen) and *M.* (*Arabica*) *arabica asiatica* Schilder & Schilder are common in both islands. *Pustularia* was met with frequently only in Takarazima.

Muricidae: *Drupa* (*Drupa*) *morum* Röding and *Drupa* (*Drupa*) *ricina* (L.) are common in both Takarazima and Nakanosima, slightly commoner in the former locality than in the latter. *Drupa* (*Cronia*) *margariticola* (Broderip), *Drupa* (*Morulina*) sp. (No. 129) and *Drupa* (*Drupa*) *albolabris* (Blainville) were found rather commonly in Takarazima, but not found at all in Nakanosima. *Purpura kieneri* (Deshayes) was found in both islands, while shells of *Purpura persica* (L.) and *P. rudolphi* (Lam.) were found only in Nakanosima. *P. persica* and *P. rudolphi* are generally used for food by the inhabitants in Nakanosima and this is the reason

why remains of these snails were found abundantly on that island.

Buccinidae: *Engina mendicaria* (L.) is common on the reef in both islands.

Mitridae: *Mitra* (*Strigatella*) *virgata* Reeve and *Mitra* (*Strigatella*) *decurtata* Reeve are common in both islands. A considerable number of *M.* (*St.*) *litterata* Lam. and *M.* (*St*) *zebra* Lam. were found also in Takarazima.

Conidae: *Conus* (*Virroconus*) *ebraeus* L. and *G.* (*V.*) *chaldaeus* (Röding) are the commonest conids in both islands. *C.* (*Stephanoconus*) *lividus* Bruguière, *C.* (*Lithoconus*) *flavidus* Lam., *C.* (*V.*) *fulgetrum* Sow., *C.* (*Pinoconus*) *cinereus* Bruguière and *C.* (*Rhizoconus*) *rattus* Bruguière, all yellowish brown in colour when alive, were found rather frequently.

Siphonariidae: The siphonariid fauna differs distinctly between Takarazima and Nakanosima. In the former, *Siphonaria rucuana* Pilsbry and *S. laciniosa* (L.) were found commonly, especially *S. rucuana* which was found only in this island. In the latter, *S. subatra* Pilsbry was found commonly; *S. atra* Q. & G. was found solely in this island, though few in number.

Brackish area: *Melampus caffer* (Küster) is common in both islands. *Paludinella stricta* Gould* was common in Nakanosima, while in Takarazima *Angustassiminea castanea satumana* Habe was found frequently.

Land shells: Empty shells of *Bradybaena* (*Acusta*) *despecta* (Sowerby) scattered very abundantly in "Sabaku" of Takarazima were one of the most impressive sights in this island.

2. Species found under stones.

Isognomon perna (L.) and *Planaxis* (*Angiola*) *virgatus* Smith occur commonly in both islands. The molluscs found under stones are much richer in Takarazima than in Nakanosima; namely *Pinctada panasesae* (Jameson), *Chama brassica* Reeve (var.), *Anachis* (*Zafra*) *sinensis* (Sow.), *Emarginula variegata* A. Adams, *Collonista granulosa* (Pease), *Triphora* sp., *Kermia chichijimana* Pilsbry var. and *Bittium* (*Plesiotrochus*) *oosimense* (Watson) were found in Takarazima in a considerable number. The last one of these species was found also in Nakanosima, but very few in number.

3. Some characteristics of the molluscan fauna in both islands.

Rich fauna in Takarazima: 204 species occurred in Takarazima and 141 species

* *Angustassiminea castanea satumana* Habe read in the 24 th line, p. 135, Vol. III, No. 2 of this journal must be corrected as *Paludinella stricta* Gould.

in Nakanosima. Small or delicate shells, for instance Atyids or Pteropods are found much more abundantly and perfectly in Takarazima than in Nakanosima. This is probably due to the topographic difference between the coasts of the islands. The beach of Nakanosima seems to be too rough to preserve those shells perfectly. Nevertheless, the molluscan fauna of Nakanosima has some representatives which are very rare or not included in the collection from Takarazima, namely *Septifer excisus* (WIEGMANN), *Spondylus* spp., *Tridacna* (*Vulgodacna*) *maxima* (RÖDING), *Cellana* spp., Vermiculariids and Rapids.

Differences of size and colour in some species: *Isognomon acutirostris* (DUNKER) reaches 21 mm in length in Takarazima, while most of shells from Nakanosima are less than 9 mm in length, although some stranded empty shells reach 24 mm. *Gryphaea* (*Saxostrea*) *mordax* GOULD seems to grow better in Takarazima than in Nakanosima; it reaches 40 mm×65 mm~45 mm×70 mm in size of the shell in the former, while the largest shells in the latter location are 20 mm×45 mm~25 mm ×35 mm. Some shells attached to the stones near the mouth of the brook on the western coast of Nakanosima are very irregular in shape and assume a generally peculiar appearance which may easily lead to misidentification. *Purpura kieneri* (DESHAYES), *Nerita* (*undata*) *striata* BURROW and *Nerita* (*Ritena*) *plicata* L. are all smaller in Nakanosima than in Takarazima; respectively 25 mm in height in Nakanosima and 35 mm in Takarazima, 22 mm in diameter in Nakanosima and 27 mm in Takarazima, and 14 mm in diameter in Nakanosima and 22 mm in Takarazima. Among the living animals examined, *Nerita* (*Theliostyla*) *albicilla* L. seems to be coloured darker in Nakanosima than in Takarazima. *Nerita* (*Amphinerita*) *polita* L. shows the same tendency and at the same time shows a richer variety of colouration and pattern in Nakanosima.

Occurrence of tropical shells in Takarazima: *Cassis cornuta* (L.), *Strombus* (*Aliger*) *latissimus* L. and *Lambis lambis* (L.) were observed only in Takarazima, although they were all stranded empty shells. The shell of *Lambis* (*Harpago*) *chiragra* (L.) was found in both islands, but that observed in Nakanosima was a young one. *Turbo* (*Olearia*) *marmoratus* L., the most important gastropod in these islands both as the source of the material for the artistic shellwork and as an important source of food, is also much more abundant in Takarazima than in Nakanosima.

INVERTEBRATE FAUNA OF THE INTERTIDAL ZONE OF THE TOKARA ISLANDS

IX. CIRRIPEDIA[1)2)]

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With 2 Text-figures

The collection of Cirripedia from the Tokara Islands includes three pelagic and nine littoral species, all of which have been recorded previously from the adjacent regions (Hiro, 1939; Utinomi, 1949). The Tokara Islands, in particular Takarazima, are surrounded partly by a narrow raised coral reef, so the Cirripedian fauna in the intertidal zone is rather poor despite the subtropical situation of that islands, as represented only by small number of species in the present collection.

The cirripeds represented here are mostly well-known species, so that they call for no special description and have been given with notes on distribution. Lastly, a general account on the geographical distribution of the intertidal barnacles in the Ryukyu Islands is given, together with a list of the species recorded from the neighbouring regions.

Family Scalpellidae Pilsbry

1. *Mitella mitella* (Linné)

Jap. Name. Kamenote.
Material. Five specimens from Nakanosima (TK. No. 483).
Distribution. Widespread in the warm Indo-Pacific.

Family Lepadidae (Darwin) Nilsson-Cantell

2. *Lepas anserifera* Linné

Jap. Name. Karu-ebosi.
Material. Two specimens from Nakanosima (TK. No. 484). Eight specimens from Takarazima (TK. No. 485).

1) Scientific Survey of the Tokara Islands, Report No. 11.
2) Contributions from the Seto Marine Biological Laboratory, No. 235.

Distribution. Pelagic in tropical and temperate seas.

3. *Lepas pectinata* SPENGLER

Jap. Name. Ruri-ebosi.

Material. Several small specimens on a pumice stone from Takarazima, together with *Lepas fascicularis* (TK. No. 486).

Distribution. Pelagic in all seas.

4. *Lepas fascicularis* ELLIS et SOLANDER

Jap. Name. Uki-ebosi.

Material. One small specimen on a pumice stone from Takarazima, together with *Lepas pectinata* (TK. No. 486).

Distribution. Pelagic, chiefly in tropical and temperate seas.

Family Chthamalidae DARWIN

5. *Chthamalus malayensis* PILSBRY

(Fig. 1)

Chthamalus malayensis PILSBRY, 1916, p. 310, pl. 72, figs. 5, 5a; BROCH, 1931, p. 55; NILSSON-CANTELL, 1938, p. 31; HIRO, 1939, p. 250.
Chthamalus moro PILSBRY, 1916, p. 311, pl. 72, figs. 6, 6a, 6b; BROCH, 1931, p. 56; NILSSON-CANTELL, 1934, p. 50; HIRO, 1937, p. 49; HIRO, 1939, p. 249.
Chthamalus challengeri f. *krakatauensis* BROCH, 1931, p. 53.

Jap. Name. Minami-iwahuzitubo. (nom. nov.)

Material. Numerous specimens from Nakanosima (TK. No. 487). Several specimens on stones and *Tetraclita squamosa* from Takarazima (TK. No. 488).

A lot of *Chthamalus* from the Tokara Islands caused much trouble. The specimens are strongly ribbed and depressed, except only those seated on *Tetraclita* which are conic in form. At first I was inclined to regard some larger specimens selected from the material as typical *Chthamulus malayensis*, but after studying the opercular valves I found such a close resemblance to PILSBRY's description that there can be no doubt that most of the specimens belong to *Chthamalus moro.* This led me to re-examine the many representatives of *Chthamulus* collected from Palao and from Formosa, which I have recorded in the past as either *Ch. moro* or *Ch. malayensis.*

According to a key given by PILSBRY (1916, p. 297) and NILSSON-CANTELL (1938, p. 30), *Ch. malayensis* is clearly distinguishable from *Ch. moro* by the differences of the opercular valves, as follows:—

Tergum triangular, very narrow at the lower end, with nearly straight basal margin; tergal margin of scutum decidedly shorter than the basal, with a pro-

minent articular ridge about median or above, its lower end gradually sloping. ..... *Ch. malayensis.*

Tergum nearly of the same width above and below, with broad rounded spur at base; tergal margin of scutum nearly as long as the basal, with a rather weak articular ridge below the middle, its lower end abruptly truncate.....*Ch. moro.*

In a large series of specimens from Formosa, these differences in the opercular valves are more or less clearly defined so as to refer them to either of the two species. In the present collection, however, I have found that all the points of difference specified as cited above are present in varying degree in individual specimens taken from the same rock face, and that no clear lines of demarcation could be drawn between the two species on the basis of these characters in the opercular valves.

For comparison some drawings of the opercular valves are given here, one showing good agreement with PILSBRY's figures of *Ch. malayensis*, while the others with those of *Ch. moro*. Doubt is thus raised as to the validity of the differentiation.

The general outline of the opercular valves combined together coincides well with the shape of the orifice, which is rhomboidal as seen from above. In fairly grown and more depressed specimens, the orifice often tends to lengthen rostrad. Therefore, the scutum becomes more elongate triangular and eventually the basal margin of the tergum becomes nearly straight. The suture between the scutum and tergum, which is typically simple as in *moro*-form, becomes more zigzag, showing varying degree of development of the articular ridge, as I have already commented on the similarity of *Octomeris brunnea* to NILSSON-CANTELL's *Octomeris intermedia* (HIRO, 1939). The strength of the articular ridge as well as the articular furrow is apparently varied partly in accord with the growth of valves, hence the sutural edges increasing in thickness. All the specimens showing such variation of opercular valves are indistinguishable externally.

I therefore conclude that *Ch. malayensis* and *Ch. moro* are synonymous and that such differences as found in the opercular valves are merely individual. If this suggestion be accepted, it should be named *Ch. malayensis*, since the latter is preceded to *Ch. moro* by page priority.

But it may be objected from the several alleged internal disparities between the two, in particular with regard to details of the mandible and terminal segments of cirrus II. According to previous descriptions of *Ch. malayensis* by PILSBRY and by NILSSON-CANTELL, the mandible has about 6 coarse spines only in place of a comblike row of smaller spines below the fourth, and cirrus II has no large-toothed spines on the terminal segment. In the present collection, however, the mandible has a series of fine comblike pectination as in many species of the genus. Similar feature is found also in specimens from Palao and Formosa. Cirrus II has finely serrate spines on the terminal segments but without large-toothed spines, as in specimens from Palao. In specimens recorded as *Ch. malayensis* from Suô, Formosa, however, cirrus

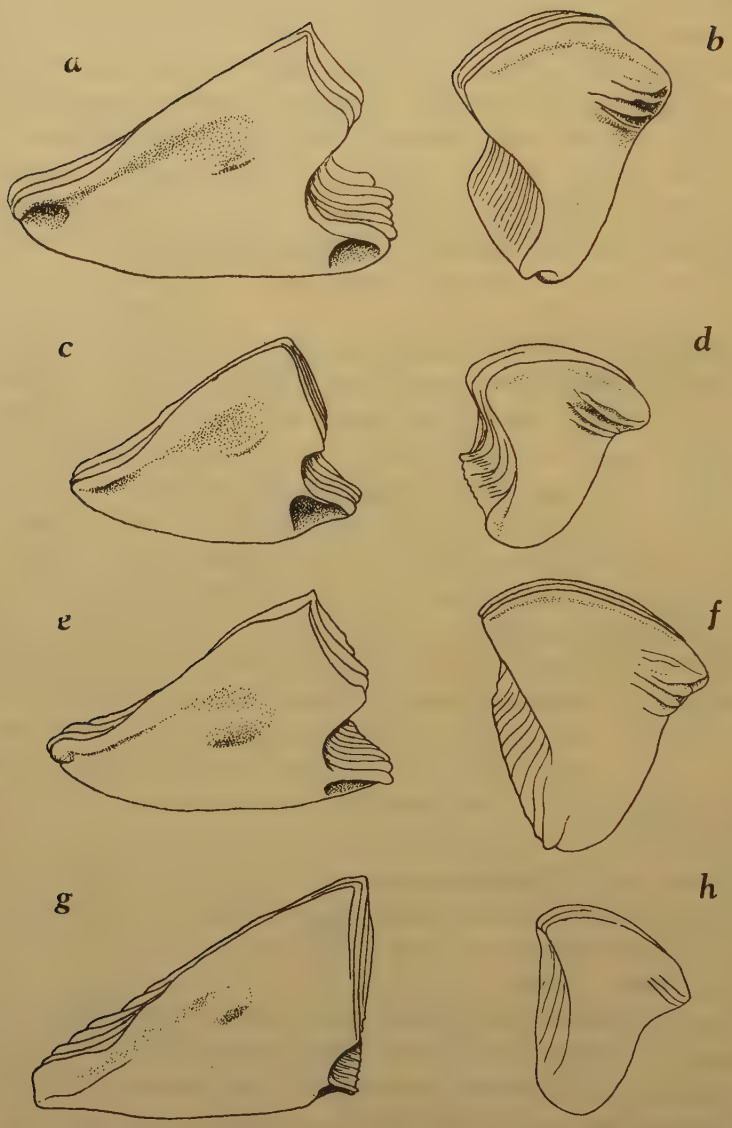

Fig. 2. *Chthamalus malayensis* PILSBRY. Inside of scutum (*a*, *c*, *e*, *g*) and tergum (*b*, *d*, *f*, *h*). *a*, *b*, from Tokara Islands (typical form). *c*, *d*, from Tokara Islands (*moro*-form). *e*, *f*, from Palao Islands (typical form). *g*, *h*, from Palao Islands (*moro*-form). (All ×14)

II has two coarse teeth a little below the serrate portion among the terminal spines.

Whether these differences in the cirri and mandibles are constant everywhere so as to have specific or racial significance remains to be investigated. Probably, these internal characters also may be in many cases subject to considerable variation.

The major morphological characters of the opercular valves common to the two forms *malayensis* and *moro* are as follows:—In the scutum, the adductor ridge is very weak or rudimentary, though the adductor pit rather deep, and the pit for lateral depressor muscle is very deep and prominent. In the tergum, the interior is evenly flattened, the articular ridge not distinctly delimiting from the rest of inner face, and the basal margin is slightly notched just below the short crests for carinal depressor muscle which are usually 4 in number.

At any rate, it seems justified to regard these specimens as a single species and to refer them to *Ch. malayensis*, as identical with *Ch. moro*.

Distribution. Northeast of Indian Ocean, Malay Archipelago, Palao, Philippines and Formosa.

6. *Chthamalus pilsbryi* Hiro

(Fig. 2)

Chthamalus pilsbryi Hiro, 1936, p. 227; Utinomi, 1949, p. 21.

Jap. Name. Ô-iwahuzitubo.

Material. About thirty specimens from Nakanosima (TK. No. 489).

This species, apparently endemic to Southern Japan, occurs on rocks near the high tide mark. This is easily distinguishable from other chthamalids living together by its relatively large size and by the complicately interlocked opercular valves.

Among a lot of specimens, curiously enough I found an unusual example with

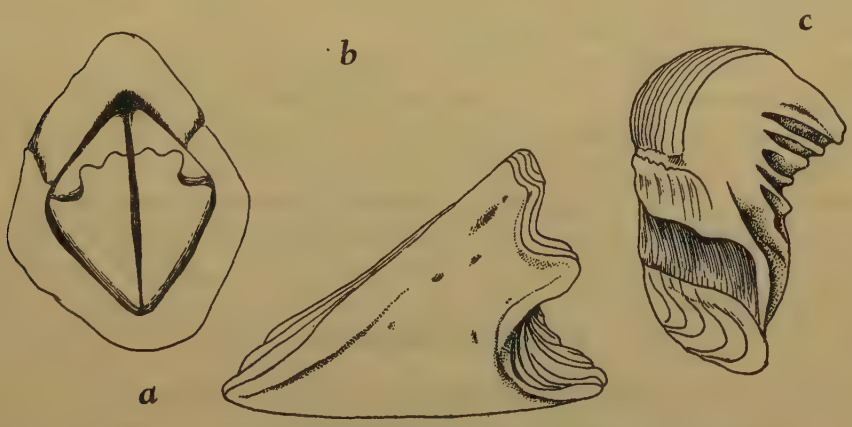

Fig. 2. *Chthamalus pilsbryi* Hiro.
a, Abnormal specimen, with compartments fused together.
b, Inside of scutum. *c*, Inside of tergum. (a ×4; b, c ×22)

the shell composed of only two plates (Fig. 2a). One of the plate is undoubtedly the carina, whilst the other large one is the remaining compartments coalesced togetner, sutures between them being completely obliterated even on the inside. The opercular valves, however, are typical for the species, as figured here. The interior of the scutum is much punctured with small holes, but no pits or scars for the adductor and depressor muscles are visible. The tergum is extremely thick, with prominent crests for depressor muscle, 5 or 6 in number, all along the basal margin.

Distribution. Kii coast, Murotozaki, Aosima, Amakusa Is., and Tanegasima, all along the surf-washed coast under the influence of 'Kurosio'.

7. *Chthamalus intertextus* DARWIN

Chthamalus intertextus DARWIN, 1854, p. 467, pl. 19, figs. 1a, 1b; PILSBRY, 1916, p. 324; HIRO, 1939, p. 251; UTINOMI, 1949, p. 29.

Jap. Name. Utimurasaki-iwahuzitubo. (nom. nov.)

Material. Numerous specimens from Nakanosima (TK. No. 490) and from Takarazima (TK. No. 491).

This species is, according to TOKIOKA (1953), more prevalent in the mid-tidal zone below the littorinid zone than *Ch. malayensis*, and epibiotic in habitat. The shell is largely corroded and dirty white externally, but beautiful violet within. The suture between the scutum and tergum is usually obsolete externally by the fusion of the valves, but rarely distinct.

Distribution. Hawaii, Philippines, Formosa, and Ryukyu Islands.

8. *Octomeris brunnea* DARWIN

Octomeris brunnea DARWIN, 1854, p. 484; HIRO, 1939, p. 252 (for synonymy and references).

Jap. Name. Kiku-huzitubo. (nom. nov.)

Material. Several specimens from Nakanosima (TK. No. 492).

This is characterized by the remarkably depressed wall formed of 8 closely-ribbed compartments with serrate sutural edges. The largest specimen in the collection is 24 mm in carino-rostral diameter, with a height of 4 mm.

Distribution. Indian Ocean, Malay Archipelago, Philippines, and Formosa. The northermost locality so far recorded is Miyakezima (34°5′ N., 139°32′ E.), about 200 km south of Tokyo (HIRO, 1932).

Family Balanidae GRAY

9. *Balanus tintinnabulum occator* DARWIN

Balanus tintinnabulum occator HIRO, 1939, p. 260 (with references).

Jap. Name. Minami-akahuzitubo. (nom. nov.)

Material. Six specimens from Takarazima, attached to coral limestone (TK. No. 493).

The specimens are rather small, the largest one being 18 mm in carino-rostral diameter and 12 mm in height. The shell is dirty white, tinged with dull purplish drab. Parietes are broadly ribbed and often with downward-directing spines on the lower half.

This species is a typical inhabitant of coral reefs, so that it is often overgrown by the coral (KOLOSVÁRY, 1950).

Distribution. Indo-Pacific only: Zamboanga (Mindanao), Pulu Tusa near Halmahera Is. (Malay Archipelago), Fiji Islands, Bonin Islands, and Formosa.

10. *Tetraclita squamosa viridis* DARWIN

Jap. Name. Minami-kurohuzitubo. (nom. nov.)

Material. Numerous specimens from Nakanosima (TK. No. 494).

This well known Malayan race, which is characterized by the bluish green colouration, is very abundant in the lower tidal zone in both the islands, Nakanosima and Takarazima. The wall is often covered with a cluster of *Chthamalus malayensis* or/and *Vermetus reniscatus*, a small coiling gastropod.

Distribution. Widespread in the Indo-Pacific.

11. *Tetraclita squamosa formosana* HIRO

Tetraclita squamosa formosana HIRO, 1939, p. 271; UTINOMI, 1949, p. 23.

Jap. Name. Taiwan-kurohuzitubo. (nom. nov.)

Material. Numerous specimnes from Nakanosima (TK. No. 495) and from Takarazima (TK. No. 496).

This Formosan race of the reddish colouration is also plentiful in the intertidal zone of the Tokara Islands as on the Formosan coasts.

Distribution. Formosa, Tanegasima, and Kii coast.

12. *Tetraclita* (*Tetraclitella*) *chinensis* (NILSSON-CANTELL)

Tetraclita purpurascens chinensis HIRO, 1939, p. 273.
Tetraclita (*Tetraclitella*) *chinensis* UTINOMI, 1949, p. 36.

Jap. Name. Mutuana-hirahuzitubo. (nom. nov).

Material. One specimen without opercular valves from Nakanosima (TK. No. 497).

Distribution. Hongkong, Formosa and Southern Japan, as far north as Sagami Bay.

Zoogeographical Remarks

The Ryukyu Islands Group, lying just between Kyusyu and Taiwan (Formosa),

has been considered as an actual bridge for the mixture or extension of ranges of both temperate and tropical forms, and offers many possibilities for faunal comparisons. But there are to date very few published records for barnacles as well as other intertidal faunas. The reason for the dearth of information lies largely in the fact that the islands are too remote and rather hard to explore thoroughly on various islands, mostly cliffed around the coasts, and zoogeographers merely consider that the marine fauna as a whole is representative of the Taiwan-Ryukyu province predominated by the tropical Indo-Malayan elements. In my opinion, however, the extensive ranges of intertidal barnacles together with the isolation of populations on various islands offer many possibilities for the study of speciation and ecological adaptations.

While the survey made on the Tokara Islands (actually worked at only two isles, Nakanosima and Takarazima, at the northern and southern ends), cannot be said to be complete, a lot of specimens of the intertidal barnacles here described should present a fairly adequate idea as to the distributional ranges of the tropical and temperate forms, in connection with their occurrence in Formosa and Japan proper which I have confirmed myself.

Of the nine species or subspecies of intertidal barnacles taken in the Tokara Islands, only one *Chthamalus pilsbryi* is limited to Japanese waters and the remaining eight are truly the southern forms. Of the latter, however, five extend by the aid of the 'Kurosio' Current to more northern parts of Japan, viz., *Mitella mitella* extending to southern Hokkaido, *Tetraclita squamosa viridis* and *T. chinensis* to Sagami Bay, *T. squamosa formosana* to Kii coast and *Octomeris brunnea* to Miyakezima, about 200 km south of Sagami Bay, though the last two only rarely found there.

At the northern end of Tanegasima at which I made a collection of intertidal barnacles during my short stay in 1943, the following five species were found to occur commonly. Namely, *Chthamalus pilsbryi*, *Ch. challengeri*, *Tetraclita squamosa japonica*, *T. squamosa viridis*, *T. squamosa formosana*, *T. chinensis* and *Octomeris sulcata*. Most of them have their homes in Japanese waters, excepting *formosana* in Formosa and *viridis* in more southern warm waters. Among three subspecies of *Tetraclita squamosa*, *viridis* was predominant, while *formosana* and *japonica* were not so abundant. None of the species of *Chthamalus* excepting *Ch. pilsbryi*, which are common in the Tokara Islands, were found there.

To these may be added the subspecies of *Balanus tintinnabulum* inhabiting on surf-washed rocky coasts in the lower tidal zone or sublittoral (or infralittoral) fringe. Specimens found at Tanegasima belong to the Japanese race *volcano*, while those obtained at Takarazima is the Malayan race *occator*, ranging from the Bonin Islands to the South Pacific or to the Indian Ocean.

An analysis of these data on the distribution of intertidal barnacles in the northern part of Ryukyu Islands shows that in general their occurrence is consistent with the provinces designated by NOMURA and HATAI (1936) based mainly on molluscs

Distribution of intertidal sessile barnacles on various islands between Kyusyu and Taiwan.

Latitude N. (approximately)	←31°	31°	30°	29°	28°	27°	25°	25°→
Islands (from N. to S.)	Kyusyu	Tanegasima	Nakanosima	Takarazima	Amami-ôsima	Okinawazima	Isigakizima	Taiwan
Chthamalus pilsbryi	←	—	—					
Chthamalus challengeri	←	—	—				?	
Chthamalus intertextus			—	—	.....	—	.....	—→
Chthamalus malayensis			—	—	.....	.....	.....	—→
Tet. squamosa japonica	←	—	—				?	
Tet. squamosa viridis	←	—	—	—	.....	—	—	—→
Tet. squamosa formosana	←.....	—	—	—	.....	.....	.....	—
Tetraclita chinensis	←	—	—	.....	.....	.....	—	—→
Octomeris sulcata	←	—	.....	.....	.....	.....	—	—
Octomeris brunnea			—	.....	.....	.....	.....	—→
B. tintinnabulum volcano	←	—	—				?	
B. tintinnabulum occator				—	.....	.....	.....	—→

Arrow indicates further extension of range to its direction. Bold and dotted lines indicate actual and probable occurrence respectively.

and brachiopods. Further work on the distribution of barnacles in the neighbouring islands or localities will undoubtedly extend many ranges, but at present the most pronounced faunal break is in the vicinity of Nakanosima, approximately the latitude 30°N., as can be clarified in the accompanying table. In an earlier paper (UTINOMI, 1949), I have suggested that a wide gap between Tanegasima and Amami-ôsima, where the Tokara Islands are located, may interrupt or control the further extension of ranges of the northern and southern forms. All the evidence thus points to the fact that most of the common intertidal barnacles along the Formosan coasts, in accord with earlier observations, do not extend as far north as Tanegasima.

On the other hand, the faunal difference for intertidal barnacles between Nakano- and Takarazima is very slight in comparison with that between Tanegasima and Nakanosima. A striking physiographical difference is the existence of the raised and recent fringing reef all around the coast of Takarazima, against the other islands concerned where the coral reef is considerably less developed. The dominancy of *Ch. intertextus* and the occurrence of *B. tintinnabulum occator* at Takarazima are probably correlated with the presence of raised coral reefs. The same may be said for the absence of *Mitella mitella* and various races of *Balanus amphitrite* there, since they are rather confined to sheltered habitats such as harbours and moles. Furthermore it may be worth mentioning that *Ch. moro*, recorded as such, seems to

be an inhabitant of rather calm waters, as shown by earlier records mostly from mangrove trees or submerged barks, and it may be variant of the typical *Ch. malayensis*, adapted to sheltered habitat.

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INVERTEBRATE FAUNA OF THE INTERTIDAL ZONE OF THE TOKARA ISLANDS

X. NEMERTINI[1]

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With 2 Text-figures

This paper deals with three species of nemerteans collected from Nakanoshima in the Tokara Islands, Kagoshima Prefecture, by Dr. T. TOKIOKA who stayed there in several days during the period of the expedition to the Tokara Islands from May 25 to June 12 of 1953. These species belong to the Anopla, including two known and one new species.

Before proceeding further, I wish to tender my cordial thanks to Dr. Takasi TOKIOKA of the Seto Marine Biological Laboratory of the Kyoto University for his kindness in placing these materials at my disposal.

Lineus albovittatus (STIMPSON), 1855

(Figs. 1 A & 2)

Mechelia albo-vittata: STIMPSON, 1855.
Cerebratulus albovittatus: STIMPSON, 1857.
Lineus albovittatus: BÜRGER, 1904.

The body is 2 cm long and 1.5 mm wide. The body is white in colour with a broad longitudinal band of velvet-green throughout the dorsal side of the body. The head is anteriorly round in outline from above and is only demarcated from the rest of the body by the dorsal colouring which is narrowed in the neck, with a broad white transverse stripe on its posterior portion, and V-shaped on its anterior margin. The opening of the rhynchodaeum is situated at the tip of the head. The body in preservation is as follows: Colour dull whitish yellow. Head somewhat wider than the portion just following, slightly bends dorsally, and much flattened dorso-ventrally. Mouth showing an oval-shaped longitudinal pore situated just behind the neck. Lateral cephalic grooves distinctly found along the lateral sides of the head. In transverse

1) Scientific Survey of the Tokara Islands, Report No. 12.

sections of the head, about 20 ocelli are found along the upper lip of the lateral cephalic groove.

Internal structure. The cephalic glands are not voluminous, extending posteriorly to the portion far ahead the brain. The lateral cephalic groove is deep and widened inwards, and forms a truncated isosceles triangle in cross section, extending posteriorly to the lateral side of the brain. The dorsal ganglion is two times the size of the ventral one and divided posteriorly into two lobes, of which the dorsal one is smaller and shorter, while the ventral one is large and connected with the cerebral sense organ through its hinder end. The cerebral sense organ is situated laterally to the

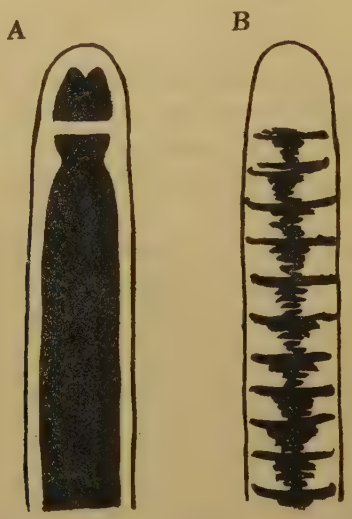

Fig. 1. A. *Lineus albovittatus* (STIMPSON). Dorsal view of the anterior portion of the body. B. *Lineus nigrostriatus* sp. nov. Dorsal view of the anterior portion of the body.

lateral nerve cord. A narrow canal is anteriorly sent out from the cerebral sense organ and the hinder end of the lateral cephalic groove is situated laterally to the brain. A pair of the oesophageal nerves with one commissure in the posterior portion of the brain in front of the mouth originates from the inner sides of the anterior portion of the ventral ganglion, running posteriorly along the ventro-lateral side of the mouth. The mouth is enormously long and widened laterally, reaching anteriorly the posterior portion of the brain. The cutis is not well developed, being about a half the thickness of the circular muscle layer in oesophageal region. The layer of the cutis glands is demarcated from the outer longitudinal muscle layer by a thin layer of the connective tissue. The outer longitudinal muscle layer is about 2–3 times the thickness of the circular muscle layer in the oesophageal region. The proboscis sheath is present only in the anterior portion of the body. The proboscis is

provided with two muscle layers (outer longitudinal) and with two muscle crosses. The cephalic blood lacunae are not voluminous. The dorsal and lateral blood vessels are filled with the large eosinophile blood corpuscles. The nephridia are composed of branched ducts, extending from the posterior portion of the cerebral sense organs to the posterior portion of the stomachic region, and sending off laterally five efferent ducts, which pass just above the lateral nerve cords. Of the five efferent ducts, two are situated in the right half of the body. The frontal organs are wanting.

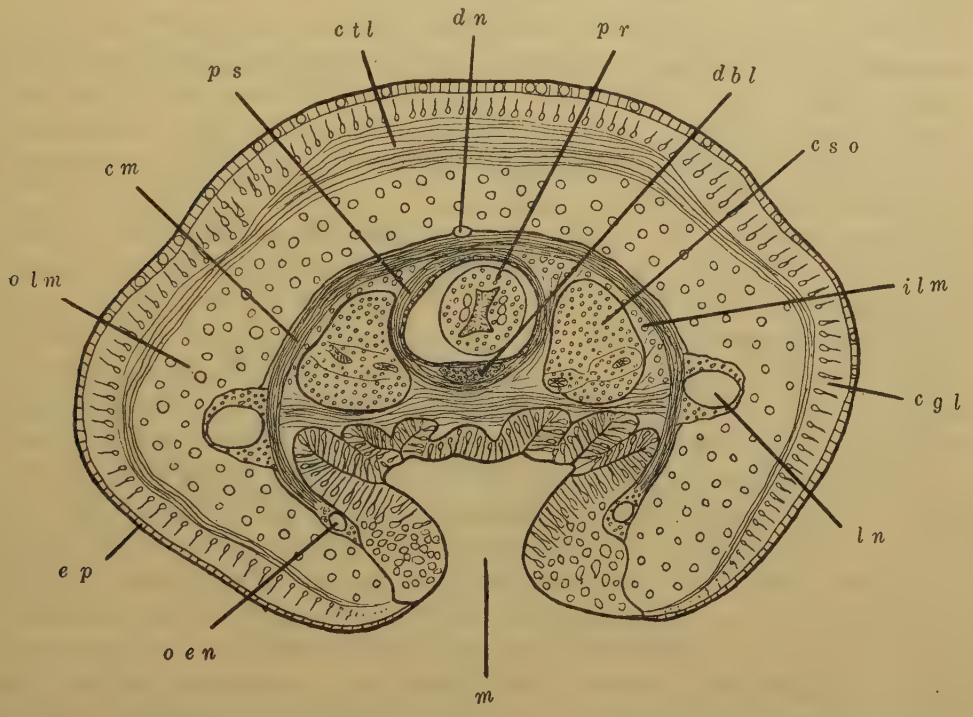

Fig. 2. *Lineus albovittatus* (STIMPSON). Cross section in the anterior portion of the body, showing the arrangement of the organs, such as the cerebral sense organs, the lateral nerves and the mouth.; *cgl.* cutis glands, *cm.* circular muscle layer, *cso.* cerebral sense organ, *ctl.* connective tissue of the cutis, *dbl.* dorsal blood lacuna, *dn.* dorsal nerve, *ep.* epithelium, *ilm.* inner longitudinal muscle layer, *ln.* lateral nerve, *m.* mouth, *oen.* oesophageal nerve, *olm.* outer longitudinal muscle layer, *pr.* proboscis, *ps.* proboscis sheath.

Remarks. The material agrees in the external characters of the body with the description of *L. albovittatus* reported by STIMPSON (1855), who gave no accounts of the internal structure. In the internal structure, however, the species shows some affinities to *L. geniculatus* reported by BÜRGER.

Locality. Nakanoshima, one specimen (TK. No. 498).

Distribution. The Loo Choo Islands.

Lineus nigrostriatus sp. nov.

(Fig. 1 B)

The body is long, slender and about 15 cm long and 2 mm wide. The body is white in colour with a greyish green pattern which is composed of many transverse stripes regularly arranged on the dorsal side of the body and of numerous short bands which are closely approximated between every two of these stripes. The form and colour of the body preserved in alcohol are as follows: Body about 13 cm long and 2 mm wide, anteriorly rounded in outline from above, but sharply pointed in the tail. Head somewhat wider than the succeeding portion of the body. Body equally dull whitish yellow in colour, showing no dorsal pattern. Dorsal surface of the head darker in colour than the portion immediately followed. Ocelli wanting. Opening of the rhynchodaeum situated at the subterminal portion of the head. Lateral cephalic groove measuring about 2.5 mm in length.

Internal structure. The frontal organs are markedly large and consist of three canals which are provided with high columnar cells containing large nuclei and with numerous long cilia and of three groups of sensory cells situated behind these canals. The cephalic glands are wanting. The lateral cephalic groove is shallow but it reaches posteriorly the lateral side of the brain. The dorsal ganglion is about two times the size of the ventral one and posteriorly divided into two lobes, of which the dorsal one is small and short, while the ventral one is large and connected with the cerebral sense organ, which extends into the lateral blood lacuna and is situated above the lateral nerve cord. The mouth is present just behind the cerebral sense organs. An oesophageal nerve originated from the inner sides of the anterior portion of the ventral ganglions is connected with two lateral nerves delivered from the lateral nerve cords in front of the mouth and is divided into two branches running posteriorly along the lateral sides of the mouth. The cutis is not well developed, being nearly same the thickness of the epithelium in oesophageal region. The connective tissue layer is wanting. The outer longitudinal muscle layer is about two times the thickness of the circular muscle layer in the oesophageal region. The proboscis sheath is present only in the anterior portion of the body. The proboscis is provided with three muscle layers (outer longitudinal) without muscle cross.

Remarks. The species is characteristic in colour, the conspicuous frontal organs and the unpaired oesophageal nerve.

Locality. Nakanoshima, one specimen, holotype (Type 151).

Baseodiscus hemprichi (EHRENBERG), 1831

Eupolia hemprichi: BÜRGER, 1895; PUNNETT, 1901 and 1903; GRAVELY, 1927.
Baseodiscus hemprichi: BÜRGER, 1904; PUNNETT, 1909–1910; YAMAOKA, 1939.

The body in preserved state is about 50 cm long and 7 mm wide in the anterior

portion and gradually narrowed posteriorly, ending to a blunt point. The body is white in colour, with a longitudinal brown streak on both dorsal and ventral surface of the body.

Locality. Nakanoshima, one specimen (TK. No. 500).

Distribution. Tôshima, at Shirahama, Japan ; Suô and Kizan, north-eastern coasts of Formosa ; the Red Sea, the Indian Ocean, the South Pacific Ocean and Malay Peninsula.

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SOME NEMERTEANS FROM THE COASTS OF THE KII PENINSULA[1)]

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With 3 Text-figures

This paper deals with twelve species of nemerteans from the coasts of the Kii Peninsula, middle Japan, including two ones which seem to be new to science and a previously unknown one from Japan. Though four of the species included here were collected by myself from the coasts of Shirahama and Kushimoto in the spring of 1951, the others were offered me for identification by the courtesy of Dr. H. UTINOMI. The materials of the latter ones were partly represented already in the collection preserved in the Seto Marine Biological Laboratory of the Kyoto University and partly collected by Dr. UTINOMI in 1951 to 1954.

The list of the species is as follows:

Tubulanus punctatus (TAKAKURA)
Lineus piperatus (STIMPSON)
Lineus cancelli sp. nov.
Lineus geniculatus (DELLE CHIAJE)
Lineus fuscoviridis TAKAKURA
Micrura bella (STIMPSON)
Cerebratulus marginatus RENIER
Baseodiscus hemprichi (EHRENBERG)
Nemertopsis gracilis COE
Amphiporus punctatulus COE
Amphiporus insolitus sp. nov.
Tetrastemma verinigrum var. *meridianum* nov.

Before going further, I wish to express my sincere thanks to Dr. Huzio UTINOMI of the Seto Marine Biological Laboratory for his kindness in placing many materials at my disposal and the permission of publishing this paper.

1) Contributions from the Seto Marine Biological Laboratory, No. 236.

Tubulanus punctatus (TAKAKURA), 1898

Carinella punctata: TAKAKURA, 1898.
Tubulanus nothus: WHEELER, 1934.
Tubulanus punctatus: YAMAOKA, 1940; IWATA, 1954.

One specimen was collected by UTINOMI from the north coast of the Seto Marine Biological Laboratory on April 22, 1952.

Distribution. Misaki and the coasts of Hokkaido, Japan; Saldanha Bay, South Africa (WHEELER).

Lineus piperatus (STIMPSON), 1855

Meckelia piperata: STIMPSON, 1855.
Lineus piperatus: STIMPSON, 1857; TAKAKURA, 1898; BÜRGER, 1904; YAMAOKA, 1940 b.

Habitat. Rather rarely found under stones between the tide marks (by UTINOMI).

Distribution. Kikaishima and Naha, Riukiu Islands, Shimoda, Misaki, and Enoshima.

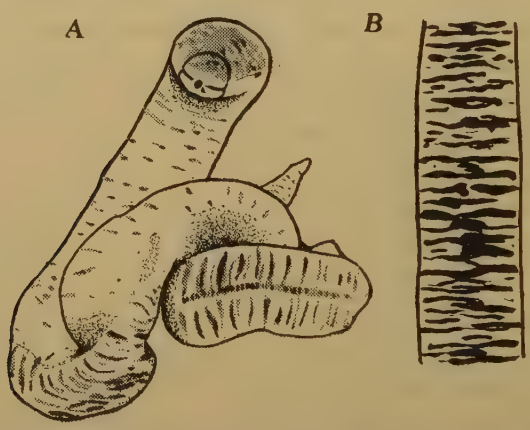

Fig. 1. *Lineus cancelli* sp. nov. A. Preserved state of the body. B. colouring of a part of the dorsal surface of the body.

Lineus cancelli sp. nov.

(Fig. 1)

The body is dull yellow in colour, marked with numerous dark brown transverse stripes which are irregularly arranged on dorsal surface of the body. They are divided into two lateral groups by the median line formed by short transversal stripes. On the ventral surface are irregularly scattered short transversal stripes. Ocelli wanting. The body in preservation is as follows: Of two specimens collected, one is shorter

and broader, being about 6 cm long and 3 mm wide, while the other is longer and narrower, being about 12 cm long and 1–1.5 mm wide. Though the head is contracted into the body, furrows of the lateral cephalic grooves and the neck are recognized. The opening of the rhynchodaeum situated at the tip of the head forms a large pore. The mouth is indistinct. A longitudinal marking is also found along either side of the body in the smaller specimen. The distal end of the tail of the smaller one is abruptly narrowed and tapers to a point, but not forming the caudal cirrus as in the genus *Micrura*.

Internal structure. The epithelium is thin and a half the thickness of the circular muscle layer in oesophageal region. The cutis is not voluminous and not marked off from the outer longitudinal muscle layer. The connective tissue layer is wanting. The outer longitudinal muscle layer is about 2 times the thickness of the circular muscle layer in the oesophageal region. The pigment granules grouped into several masses are found around the body wall between the basal membrane and the cutis. The cephalic glands and the frontal organs are wanting. The lateral cephalic grooves are narrow and reach posteriorly the lateral side of the brain. The cephalic blood lacuna is not voluminous. The dorsal ganglion is about two times the size of the ventral ganglion and not divided posteriorly into two lobes. The cerebral sense organ extends backward into the lateral blood lacuna and is situated on the dorsal side of the lateral nerve cord. The mouth is represented by a short and narrow longitudinal slit and situated in a short distance from the posterior end of the cerebral sense organs. A pair of the oesophageal nerves runs posteriorly under the rhynchodaeum and is provided with a transverse commissure in front of the foregut. The proboscis is provided with three muscle layers (outer longitudinal) without the muscle cross. The proboscis sheath is limited to the anterior portion of the body. The nephridia are situated in the oesophageal region, and send out several efferent ducts towards the latero-ventral surface of the body.

Remarks. The present new species has characteristics quite different in the external feature of the body in the genus.

Habitat. Two specimens were collected under stones between the tide marks (by UTINOMI).

Distribution. Shirahama.

Lineus geniculatus (DELLE CHIAJE), 1828

Lineus geniculatus: BÜRGER, 1895; COE, 1940; WHEELER, 1934.
Lineus digueti: JOUBIN, 1905.
Lineus mitellatus: TAKAKURA, 1895; IWATA, 1952.

The body is usually 30–60 cm long and 5–10 mm wide. It is rounded dorso-ventrally in the anterior portion of the body and is flattened in the intestinal region. The head is flattened and becomes narrow anteriorly than the succeeding portion of

the body, forming a spatula-shape from above. The middle portion of the tip of the head is protruded posteriorly. The body is variable in colour, being dark brown, purplish brown, dark purple, or bluish green. Many narrow white rings are found throughout the body. There were often found specimens without these rings in intestinal region. The first ring is situated at the middle portion of the head and thicker in width than any other ones, being protruded anteriorly in its middle portion on both the dorsal and ventral sides of the head. The tip of the head is white in colour. Though the ocelli are not observable from outside through the skin, many spots are arranged along the marginal portion of the head.

Internal structure. The cephalic glands and the frontal organs are wanting. The cutis glands are not well developed and one-third the thickness of the connective tissue layer in the portion of the mouth. The circular muscle layer is thick, being nearly same the thickness of the outer longitudinal layer in the anterior oesophageal region. The lateral cephalic grooves reach posteriorly the lateral side of the anterior portion of the brain. The cerebral sense organ extends backward to the lateral blood lacuna and is situated laterally to the lateral nerve cord. The dorsal ganglion is about two times the size of the ventral one and is divided posteriorly into two lobes. The cephalic blood lacunae are not extensive. The nephridia are provided with two pairs of efferent ducts opening externally through immediately above the lateral nerve cords. The proboscis sheath is limited to the anterior portion of the body. The proboscis is provided with two muscle layers (outer longitudinal) with two muscle crosses.

Remarks. The first record from Japan was reported under the name of *L. mitellatus* by TAKAKURA. He gave this name in recognition of the rings which entirely encircle both the dorsal and the ventral sides of the body without breaking in the middle portion of the dorsal side as in the European species *L. geniculatus* described by BÜRGER (1895), but this difference seems to me to be attributable to a local variation. The specimen having the same external feature of the body has been known from the coast of California by JOUBIN (1905) and from the west coast of Africa by WHEELER (1934). The internal structure of the present specimens agrees with that reported by BÜRGER, except the relative position of the cerebral sense organ and the lateral nerve cord.

Habitat. Rather commonly found under stones between the tide marks.

Distribution. Kushimoto, Shirahama (by UTINOMI and IWATA), Misaki (by TAKAKURA) and Tomioka, Japan; Mediterranean and Black Sea; west coast of Africa; from the coast of California southwards to the west coasts of Mexico and Panama.

Lineus fuscoviridis TAKAKURA, 1898

Lineus fuscoviridis: TAKAKURA, 1898; IWATA, 1952.

The specimens of this form were collected on Mar. 9, 1954 by Dr. Kikutaro BABA

at Kada, where it is commonly found.

Distribution. Kada, Tomioka and Misaki.

Micrura bella (STIMPSON), 1857

Cerebratulus bellus: STIMPSON, 1857.
Micrura festiva: TAKAKURA, 1898.
Lineus striatus: GRIFFIN, 1898.
Micrura bella: COE, 1901, 1905 and 1940; YAMAOKA, 1940 a; IWATA, 1954.

One specimen was collected by Dr. UTINOMI at Yuzaki, Shirahama, on Aug. 22, 1954. The external feature is as follows: Body about 10 cm long and 2 mm wide. Head orange, while the rest of the body reddish orange with narrow white transverse bands on the dorsal surface. Ventral surface wholly white. Caudal cirrus present.

Remarks. The present form resembles in its external characters to *M. bella* described by YAMAOKA (1940a), though slightly differs in colour. YAMAOKA reported that one specimen of this form was collected at Kushimoto.

Habitat. Under stones.

Distribution. Shirahama, Kushimoto, Misaki, Muroran and Oshoro.

Cerebratulus marginatus RENIER, 1804

Cerebratulus marginatus: BÜRGER, 1895 and 1904; COE, 1901, 1905 and 1940; YAMAOKA, 1940; IWATA, 1954.

One specimen was found by trawl from off the coast of the Kii Peninsula in March of 1950. The external feature of the body preserved in diluted formalin solution is as follows: — The body, about 70 cm long and 2 cm wide, is convex dorso-ventrally in the anterior portion of the body and is much flattened in the intestinal region. The body is generally pale brown in colour and in the slightly elevated marginal portion it is more whitish than the remainder.

Distribution. Misaki and the coasts of Hokkaido, Japan; the Atlantic Ocean (Europe and North America); the Mediterranean Sea; Sitka; Greenland.

Baseodiscus hemprichi (EHRENBERG), 1831

Eupolia hemprichi: BÜRGER, 1895; PUNNETT, 1901 and 1903; GRAVELY, 1927.
Baseodiscus hemprichi: BÜRGER, 1904; PUNNETT, 1909–1910; YAMAOKA, 1939.

One large specimen extended up to 8 meter in length was collected by Mr. URA at Tôshima in July, 1950.

Distribution. Tôshima, in front of the Seto Laboratory at Shirahama, and Nakanoshima (by TOKIOKA) in Tokara Islands, Japan; Suô and Kizan, northeastern coasts of Formosa (by HIRO); the Red Sea, the Indian Ocean, the South Pacific Ocean and Malay Peninsula.

Nemertopsis gracilis COE, 1904

(Fig. 2 A)

Nemertopsis gracilis: COE, 1904, 1905 and 1940.

The body is slender, nearly same in width throughout its length, and measures up to 100–120 mm long. The head is demarcated from the succeeding portion of the body. The body is dull yellow in colour and with two narrow dark brown stripes throughout the dorsal surface of the body. The stripes extend anteriorly to nearly the tip of the head and are distinct in colour in the anterior half, but gradually become paler posteriorly. Four large ocelli arranged in a rectangular shape are situated outside the stripes.

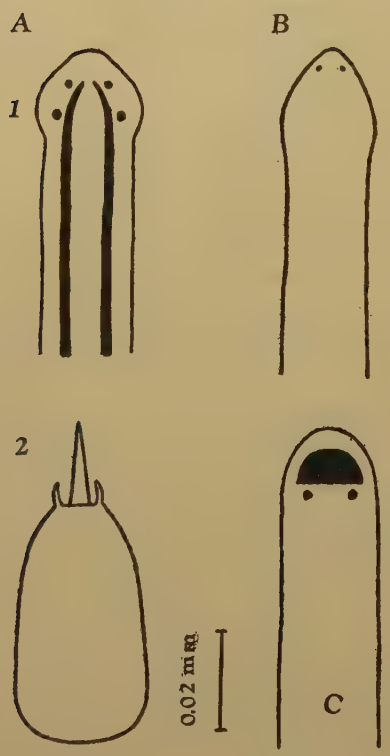

Fig. 2. A. *Nemertopsis gracilis* COE. *1.* Dorsal view of the anterior portion of the body. *2.* Lateral view of the central stylet and the basis of the proboscis.
B. *Amphiporus insolitus* sp. nov. Dorsal view of the anterior portion of the body.
C. *Tetrastemma verinigrum* var. *meridialis* nov. Dorsal view of the anterior portion of the body.

Internal structure. The cephalic glands are enormously well developed and extend posteriorly beyond the brain to the hind end of the proboscis sheath or to the most anterior reproductive organs. The proboscis sheath is limited to about one-fifth the length of the body. The basis of the central stylet is short, nearly cylindrical in

form and conical in a slightly anterior portion, being 0.047 mm long and 0.025 mm wide in a specimen. Each of two lateral pouches contains two stylets. The cerebral sense organs are small and situated short distance in front of the brain. The central stylet is short, being one-third the length of the basis. The intestinal caecum is anteriorly devoid of diverticula and is separated from the brain by its length. The dorsal ganglion is about two times the size of the ventral ganglion. The lateral nerves run posteriorly from the back of the ventral ganglion along the lateral side of the gut.

Remarks. The difference of the body between the present material and the American one lies in the distance between the anterior end of the intestinal caecum and the posterior end of the brain; the distance of the latter one is several times the length of the brain. *N. bivittata* (DELLE CHIAJE) reported by BÜRGER (1904) nearly agrees with this species in both outer and inner structure of the body except for the shape of the stylets which are lobed or five-parted in *N. bivittata.*

Habitat. Commonly found in the mantle cavity of *Mitella mitella* (by UTINOMI).

Distribution. Shirahama, Japan; Pacific Grove, California.

Amphiporus punctatulus COE, 1905

Amphiporus punctatulus: COE, 1905 and 1940; IWATA, 1951, 1952 and 1954.

Habitat. Commonly found under stones between the tide marks.

Distribution. Shirahama, Shimoda and Tomioka in Honshu, and Oshoro and Rishiri Island in Hokkaido, Japan; Kurile Islands; Isthmus Cave, Catalina Islands, California, U. S. A.

Amphiporus insolitus sp. nov.

(Figs. 2B & 3)

The body is short and slender, anteriorly convex dorsally and posteriorly flattened dorso-ventrally in the transverse section of the body, and about 4 cm long and 0.7 mm wide. The head is somewhat wider than the rest of the body. The body is dark brown in colour and devoid of any markings, and is paler towards the anterior portion of the body except the head. The ocelli are not found through the skin, but a pair of small ocellus-like spots is situated at the lower portion of the lateral side of the rhynchodeal opening.

Internal structure. The cephalic glands are voluminous, extending backward to the posterior portion of the brain along its under side, though disintegrated dorsally in the portion of the cerebral sense organs. Several ducts of the cephalic glands are situated above the anterior portion of the rhynchodaeum and lead their tips into the rhynchodeal opening. The cerebral sense organ is rather large and situated at the portion far ahead the brain, opening externally by a narrow canal on latero-ventral

surface of the subterminal portion of the head. The intestinal caeca are entirely wanting. Parenchyma is well developed in stomachic region, extending anteriorly to the portion of the cerebral sense organs. The intestinal diverticula are laterally divided into short and broad branches. The circular muscle fibers run dorso-ventrally in the parenchymatous tissue and encircle the inner side of the longitudinal muscle layer. The outer circular muscle layer of the proboscis sheath is rather well developed throughout the body, being about three times the thickness of the outer circular muscle layer of the body wall. The proboscis sheath extends posteriorly to the hind end of

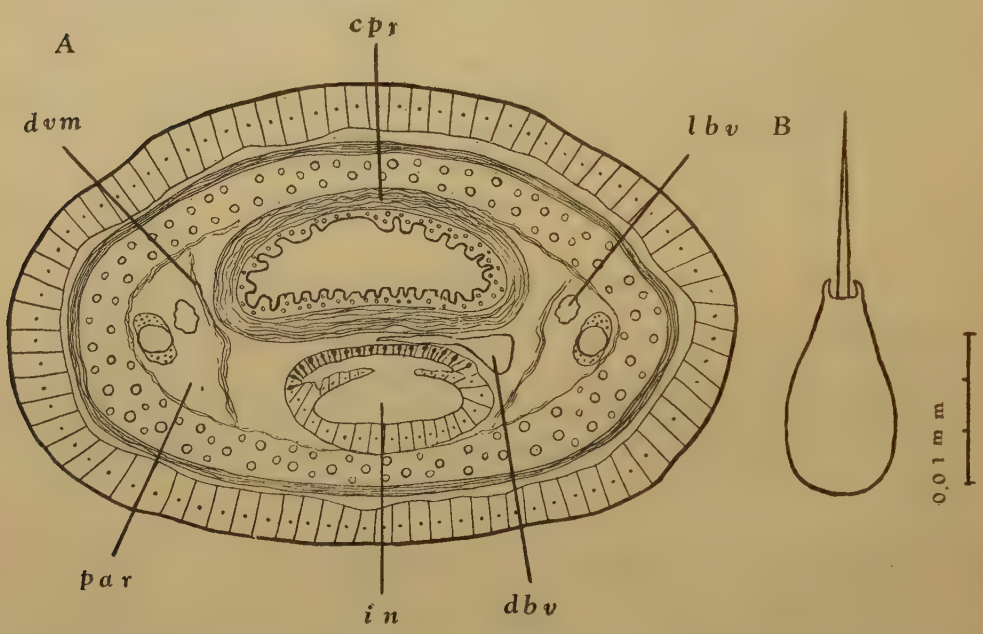

Fig. 3. *Amphiporus insolitus* sp. nov. A. Cross section of the portion of the posterior end of the stomach. B. Lateral view of the central stylet and the basis of the proboscis; *cpr.* circular muscle layer of the proboscis sheath, *dbv.* dorsal blood vessel, *dvm.* dorsoventral muscle fibres, *lbv.* lateral blood vessel, *in.* intestine, *par.* parenchyma.

the body and is provided with 14 distinct nerves. Each of two lateral pouches contains one or two stylets, one of which is 0.037 mm long. The basis of the central stylet is oval in shape and nearly same the length of the accessory stylets. The nephridia composed of several branched ducts extend posteriorly from the anterior portion of the brain to the posterior portion of the stomach. A pair of efferent ducts are sent out from the anterior portion of nephridia, and each of them opens externally on the lateral surface of the body.

Remarks. It is remarkable that this species has a pair of ocelli, a well developed

parenchymatous tissue, dorso-ventral muscle fibers and a few muscle fibers surrounding the inner side of the longitudinal muscle layer, and is devoid of the intestinal caeca which are one of the important characters of the genus *Amphiporus*.

Habitat. Only one specimen was found under a stone near low tide mark.

Distribution. Kushimoto.

Tetrastemma verinigrum var. *meridianum* nov.

(Fig. 2 C)

Tetrastemma verinigrum: IWATA, 1954.

The body is short and slender, rounded in the transverse section of the body, being about 5 cm long and 1 mm wide. The head is anteriorly rounded in outline from above and not demarcated from the succeeding portion of the body. The body is brown and posteriorly grayish brown in colour owing to the colour of the intestine. A large shield-shaped marking is found on the dorsal surface of the head and is black in colour. Two large ocelli are arranged at a short distance behind the marking, and other two ones which are situated under the marking are found in the anterior portion of the head. They are arranged in a rectangular shape.

Internal structure. The cephalic glands are well developed in three portions of the rhynchodaeum except the ventral side, extending posteriorly to the portion far ahead the brain. The cerebral sense organ is voluminous and extends from the portion slightly ahead the brain backward to the anterior portion of the brain along its latero-ventral surface. A short and narrow canal which is sent out from the cerebral sense organ, opens externally in the middle portion of the lateral surface between the tip of the head and the anterior portion of the brain. The diverticula of the intestinal caecum are rather long, extending from the posterior end of the brain to the posterior portion of the stomach. The intestinal diverticula do not branch laterally. The gonads are regularly arranged between the intestinal diverticula. Parenchyma is entirely wanting in the anterior portion of the body. The nephridia extend from the anterior portion of the brain to the posterior portion of the stomach and send off a pair of efferent ducts in the anterior portion, opening externally on the latero-ventral surface of the body.

Remarks. The present new variety agrees with *T. verinigrum* in having a black cephalic marking, but differs from the latter in colour, the longer diverticula of the intestinal caecum and the position of the cerebral sense organs.

Habitat. One specimen was found under a stone near low tide mark.

Distribution. Kushimoto and Oshoro in Hokkaido.

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SOME ALCYONIID OCTOCORALS FROM KII COAST, MIDDLE JAPAN[1)2)]

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With Plate I and 8 Text-figures

Our previous knowledge of the Japanese Alcyonaria has been derived from widely scattered references, mostly dealing with one or a few species, and from the reports of several zoological expeditions which have visited the oriental region. Among these reports are very scarce especially those recording or describing the species of the Alcyoniidae, which are mostly confined to deep-water forms, e. g. *Nidalia*, *Anthomastus* and *Bathyalcyon*. For the past several years I have engaged in collecting the shallow-water octocorals around the Kii coast, where the marine fauna as a whole is characterized, apart from the endemic element, by a number of tropical elements. Although the collection is by no means extensive, it nevertheless provides us with some new items of interest concerning the Japanese Alcyonarian fauna.

The present paper comprises nine species of the Alcyoniidae hitherto obtained around the Kii coast. Of these, one (*Microspicularia arborea*) is new to science and four (*M. digitulata*, *Sinularia gardineri*, *Sarcophyton elegans* and *Lobophytum batarum*) are recorded for the first time from Japan.

1. *Nidalia rigida* (Pütter)

(Fig. 1)

Bellonella rigida Pütter, 1900, p. 448, pl. 29, fig. 1.
Eleutherobia japonica Pütter, 1900, p. 449, pl. 29, figs. 2 & 11.
Nidalia rigida Kükenthal, 1906a, p. 33; Kükenthal, 1906b, p. 29.
Not *Nidalia rigida*[3)] Deichmann, 1936, p. 57, pl. 4, fig. 4.

1) Contributions from the Seto Marine Biological Laboratory, No. 237.
2) Supported by a grant in aid for fundamental scientific research from the Ministry of Education.
3) Deichmann's *N. rigida* from the Atlantic coast of North America is undoubtedly not the same as this Pütter's *rigida*, but apparently related to the Atlantic species *N. occidentalis* Gray. I thus propose to rename Deichmann's species as *N. deichmannae* nom. nov., if distinct from *N. occidentalis*.

Nom. Jap. Bô-umiitigo (nom. nov.).

The collection contains somewhat smaller eleven specimens, about 39–97 mm in total length. The largest figured here consists of a polyp-bearing capitulum 53 mm long, with a diameter of 15 mm at the middle and a sterile stalk, deeply shrunk and bent, about 30 mm long with a diameter of 10 mm at the base. The relative length between the capitulum and the stalk varies greatly as follows—1 : 1, 3 : 2, 5 : 3, 2 : 1, 5 : 2, 3 : 1. The base of the stalk is usually expanded, without any stolon, and attached to shell or sand particles, but rarely narrowed and roundly ended with a hint of free end in pennatulids. Probably this is due to the condition of substratum, as pointed out by KÜKENTHAL (1906b, p. 30).

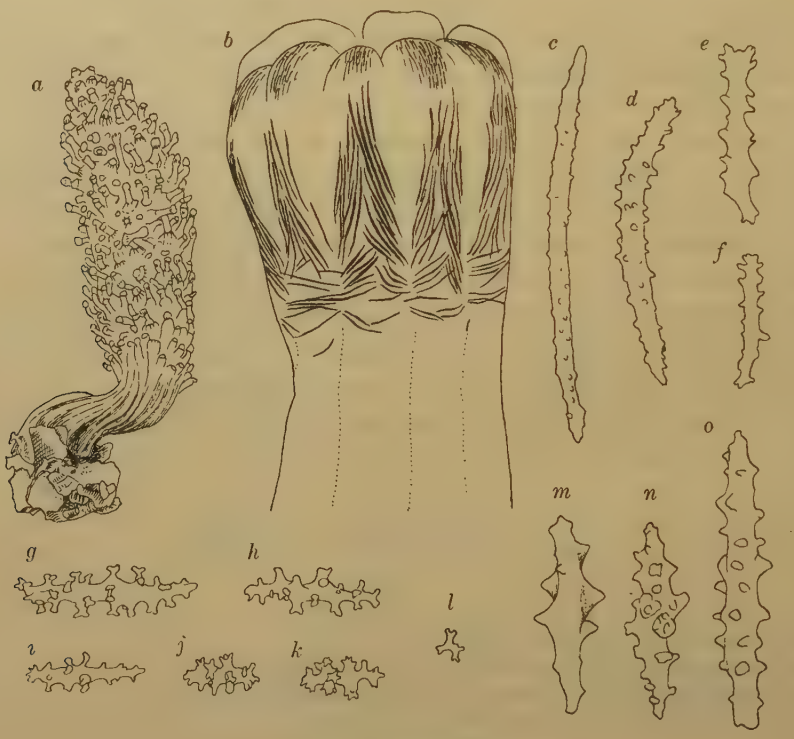

Fig. 1. *Nidalia rigida* (PÜTTER).
a, Colony; *b*, polyp to show the arrangement of spicules; *c–d*, spicules from anthocodial crown; *e–f*, from tentacles; *g–k*, from calyx; *l*, upper view of wart of calycular spicules, magnified; *m–o*, spicules from stalk cortex.
(*a*, ×1; *b*, ×26; *c–k*, *m–o*, ×150)

The spiculation agrees well with PÜTTER's and KÜKENTHAL's descriptions and figures, but the coloration differs somewhat. Most of the polyps have their anthocodial portion completely retracted within the calyx. They attain 4 mm long with a diameter of 1.3 mm when fully expanded and their calyx is 2 mm wide at the base. The tentacles bear a pair of about 15 pinnules and 0.08–0.12 mm long toothed rodlike

spicules. The anthocodial portion is thickly beset with 8 chevroned rows of rosy slender spindles, about 0.18–0.35 mm long. The neck portion is entirely devoid of spicules. The calyx rind contains smaller spindles with distinct girdles of prominent branched warts, about 0.05–0.086 mm long and 0.02–0.027 mm wide. In the rind of the stalk are found larger spindles with larger but simple warts, about 0.06–0.15 mm long and 0.03–0.047 mm wide. The canal-walls of the stalk contain similar spindles.

The ground color of the capitulum and the basal portion of calyces, as well as the anthocodial spicules is blood-red, while the main part of the stalk and the tip of calyces are dirty white.

In a largest specimen figured here, the interspace between polyps is covered with the colonies of an athecate hydroid *Hydrichthella epigorgia* STECHOW which occurs commonly on the gorgonian *Anthoplexaura dimorpha* KÜKENTHAL.

Localities. Seto, about 20–30 m. One large colony taken with the lobster-net "ebiami", UTINOMI coll., 1952.

Kii Strait, probably off Minosima, depth unknown. Ten colonies taken with beam trawls "utase", March 1950, R. ISIBASI coll.

Hitherto known only from Japan (Nagasaki, Enosima) and west of Formosa.

2. *Nidalia dofleini* KÜKENTHAL

(Fig. 2)

Nidalia dofleini KÜKENTHAL, 1906a, p. 35; KÜKENTHAL, 1906b, p. 27, text-figs. 18 & 19, pl. 2, figs. 8 & 9; THOMSON and DEAN, 1931, p. 34, pl. 5, fig. 5 & pl. 25, fig. 5.

Nom. Jap. Eda-umiitigo (nom. nov.).

Five small branched specimens agree well with KÜKENTHAL's descriptions and figures of this species. The largest one measures 45 mm in height with a basal diameter of 5 mm. The branching is two to seven times; the initial state of side branches is nothing but a prolongation of one or a few polyps grouped together. The color of the colony varies from pinkish cinnamon to red orange with the calyces generally orange. The spicules are all warty spindles, as figured here in details.

Localities. Off Minabe, 100–200 m. Five colonies, S. SAKAGUCHI coll.

Besides, I have examined also many specimens of this species, trawled off Tosa Bay which were presented to me by Dr. KAMOHARA of Kôchi University.

Previously recorded from Sagami Bay, 150 m and E. of Sumbawa Is., 69 m (East Indies).

3. *Alcyonium gracillimum* KÜKENTHAL

(Fig. 3)

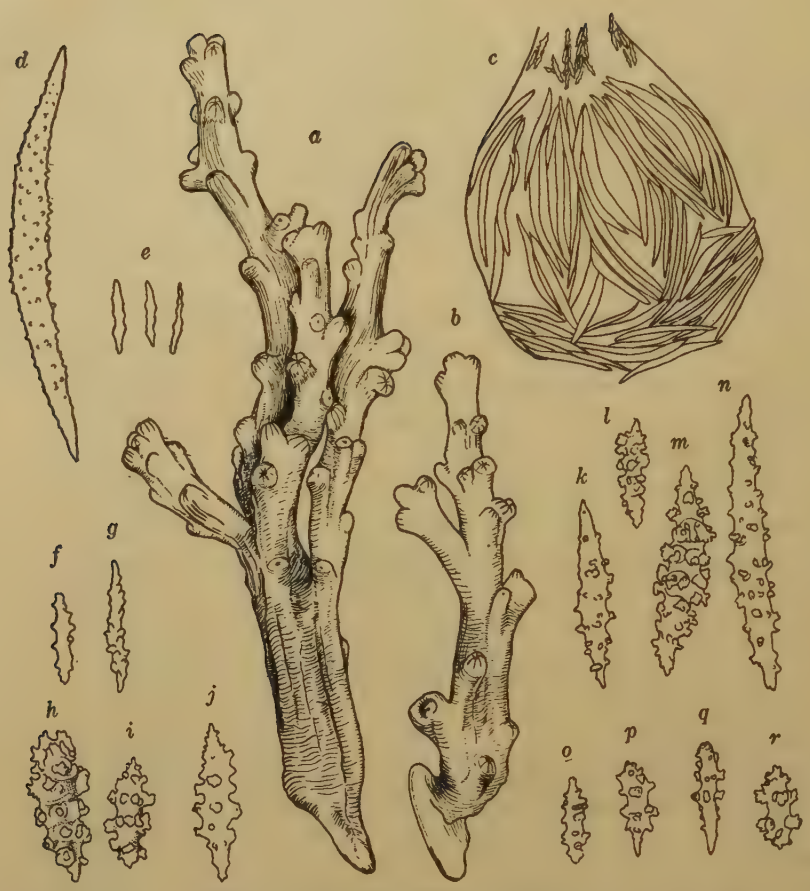

Fig. 2. *Nidalia dofleini* KÜKENTHAL.
a–b, Branched colonies; *c*, retracted polyp to show the arrangement of spicules; *d*, point spicule; *e*, spicules from neck portion of polyp; *f–g*, from tentacles; *h–i*, from stalk cortex; *j*, from stalk coenenchyma; *k–n*, from inner cortical layer of polyparium; *o–r*, from outer cortical layer of polyparium. (*a–b*, ×2; *c*, ×33; *d–r*, 100)

Alcyonium gracillimum KÜKENTHAL, 1906b, p. 34, text-figs. 25–27, pl. 2, fig. 13; NUTTING, 1912, p. 21.

Nom. Jap. Beni-umitosaka (nom. nov.).

Numerous specimens, living and preserved, from various localities along the Kii coast, are examined. The majority of them are low branched colonies covered with irregularly lobulated masses of polyps, and attain about 10 cm in total height. The base membranous, often bluntly extending like stolons, and arise one or a few plump main stems.

The retracted polyps are round cones, about 1 mm high and wide, covered with 8 chevroned curved spindles and below these transversely arranged long spindles.

These spicules are about 0.14–0.6 mm long. The stalk rind bears almost similar but longer blunt-ended spindles, mostly 0.15–0.2 mm long up to 0.3 mm long. The canal-walls are very thick and densely filled with plump spindles with large compound warts, up to 1 mm long.

The colonies are usually orange-colored in the living state, but when preserved in alcohol, the color fades away and turns to yellowish brown to dirty white.

Localities. Tanabe Bay, 5–30 m; off Minabe, 100–200 m; Kii-ôsima, 6 m.

Hitherto known only from Japan (Sagami Bay) and SW. of Sagalien.

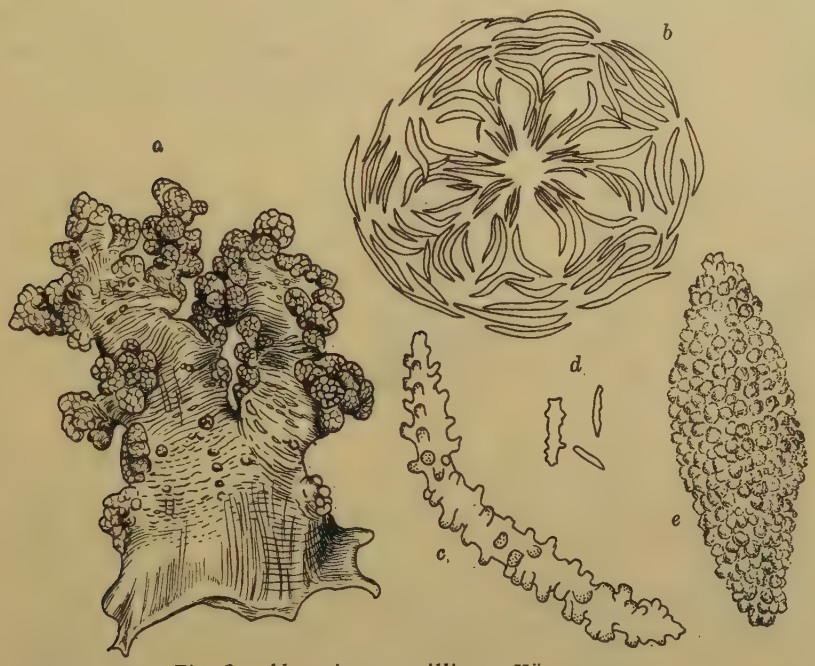

Fig. 3. *Alcyonium gracillimum* KÜKENTHAL.
a, Colony; *b*, anthocodial armature, seen from above; *c*, point spicule; *d*, tentacle spicules; *e*, coenenchymal spicule.
(*a*, ×2/3; *b*, ×33; *e*, ×55; *c*–*d*, ×150)

4. *Microspicularia digitulata* (KLUNZINGER)

(Fig. 4; Pl. I, Figs. 2 & 3)

Alcyonium digitulatum KLUNZINGER, 1877, p. 24, pl. 1, fig. 3; LÜTTSCHWAGER, 1922, p. 324; ROXAS, 1933, p. 358.

Lobularia digitulata THOMSON & DEAN, 1931, p. 39; TIXIER-DURIVAULT, 1943, p. 441; TIXIER-DURIVAULT, 1948, p. 153, text-figs. 147–153.

Nom. Jap. Yubi-nôtosaka (nom. nov.).

The encrusting alcyoniid commonly found at low tide around the coast of Tanabe Bay seems to be referable to this widespread species. All the specimens preserved

in alcohol are rather small and low encrusting in form, the largest one measuring about 95×45 mm in size of capitulum and 30 mm in maximum height. In younger colonies, each lobe on the capitulum is highly compressed, while in larger ones short and plump fingerlike, generally branched, attaining about 25 mm long and 10 mm wide at the base. In the living state, however, the fingerlike lobes extend up to about 50 mm in length.

Polyps are small, about 0.7 mm in diameter and densely set all over the lobes. The tentacles bear 4 or 5 broad pinnules on each side. Spicules are crowded at the ends of pinnules only or all along the aboral side of pinnules from the rachis of tentacles; these spicules are finger-biscuit-like to elongate discs, 0.03×0.011 mm～0.038×0.015 mm. Anthocodial spicules are similar in shape but a little larger, about 0.05×0.02 mm～0.06×0.016 mm. The spicules contained in the cortex of lobes are

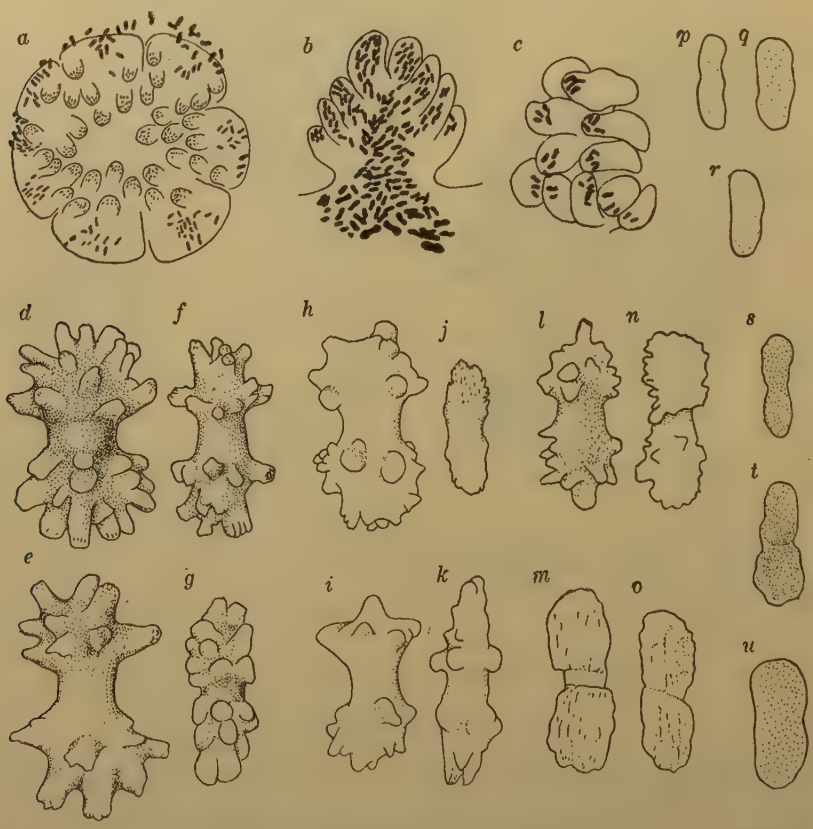

Fig. 4. *Microspicularia digitulata* (KLUNZINGER).
a, Partially retracted polyp, seen from above; *b*, tentacle bearing spicules on axis and pinnules; *c*, tentacle bearing spicules at ends of pinnules alone; *d–g*, spicules from coenenchyma of base; *h–k*, from cortex of base; *l–o*, from cortex of lobes; *p–r*, from tentacles; *s–u*, from anthocodia.
(*a*, ×55; *b–c*, ×70; *d–u*, ×335)

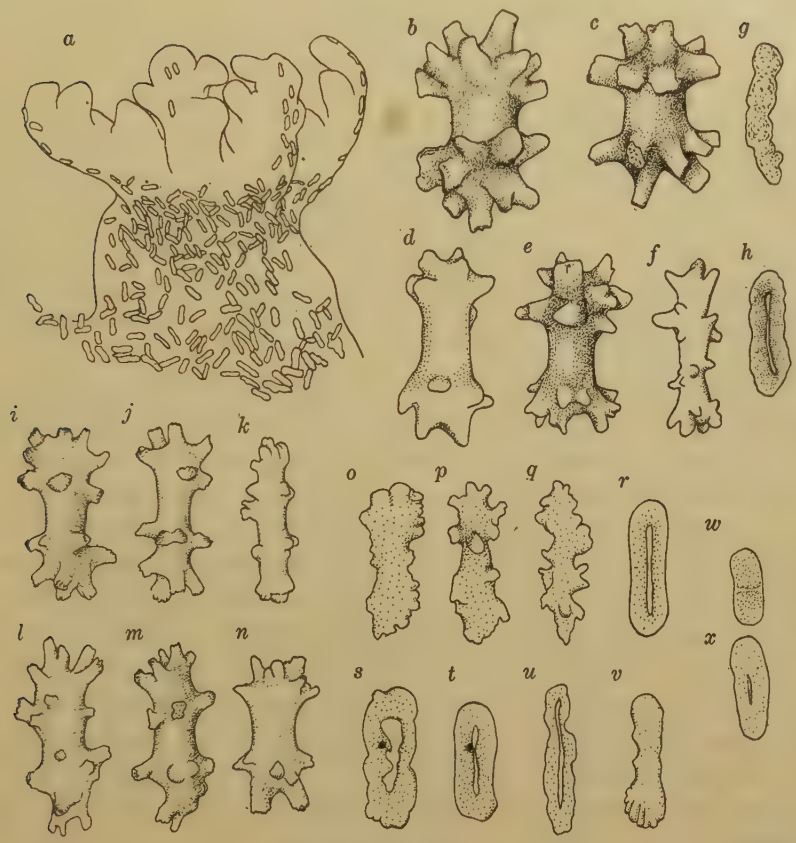

Fig. 5. *Microspicularia arborea* n. sp.
a, Polyp, seen from side; *b–h*, spicules from coenenchyma of base; *i–k*, from coenenchyma of lobes; *l–n*, from cortex of base; *o–r*, from cortex of lobes; *s–v*, from polyps; *w–x*, from tentacles. (*a*, ×55; *b–x*, ×335)

mostly roughened dumb-bells with or without a median constriction, about 0.03× 0.01 mm or thorny dumb-bells with a long waist, about 0.038×0.015 mm. Those in the cortex of the stalk are also thorny dumb-bells with a few rounded warts at ends, about 0.045×0.015 mm～0.07×0.03 mm. In the coenenchyma of the stalk are contained more tuberculated dumb-bells, with a median waist of variable length, 0.07×0.038 mm～ 0.1×0.05 mm.

Living colonies vary in color from light brown to purplish brown owing to the occurrence of zooxanthellae in endoderms. The color turns after preservation ultimately to bluish or greenish white.

Locality. Tanabe Bay, common at low tide. Probably occurs on neighboring coasts.

Previously recorded from Red Sea, Zangibar, East Indies and Philippines.

5. *Microspicularia arborea* n. sp.

(Fig. 5; Pl. I, Fig. 1)

Nom. Jap. Eda-nôtosaka (nom. nov.).

A much branched greyish-white colony (holotype) stands 75 mm in height and has a maximum spread of 90 mm. Another colony is somewhat smaller, but shows a similar appearance. From a short narrow stalk, about 25 mm across at the base, arise 4 main flexible, arborescent stems bearing many fingerlike branches and branchlets up to 2 cm long, with a diameter of 6 mm. The main stem is not distinctly delimited from the sterile stalk, as its lower part is covered scatteredly with polyps in more or less longitudinal rows.

The polyps are about 0.5 mm in diameter, 0.65 mm in height (excluding tentacles) and number about 5 to a length of 5 mm on branches. As can be seen at the partially expanded condition, the anthocodia is covered irregularly with finger-biscuit-like or elongate disc-shaped tiny spicules, about 0.05×0.01 mm$\sim$$0.06 \times 0.018$ mm, and the tentacles, about 0.5 mm long, with 3 broad pinnules on each side, bear only a few smaller spicules (0.04×0.01 mm) on the aboral side of rachis; no spicules on pinnules. In the cortex of lobes or branches are rough-edged elongate discs or cylinders with or without a median constriction, about 0.05×0.01 mm$\sim$$0.065 \times 0.02$ mm. In the canal-walls of lobes and also the cortex of sterile stalk are dumb-bells with a distinct median waist and two whorls of a few blunt-tipped warts at both ends, 0.07×0.025 mm$\sim$$0.09 \times 0.03$ mm. The canal-walls of sterile stalk contain various forms of spicules, such as:

Capstans with a cluster of blunt-ended warts at heads, about 0.07×0.03 mm$\sim$$0.09 \times 0.05$ mm.

Tuberculate cylinders, about 0.08×0.025 mm.

Elongate discs with or without a central thin zone, about 0.06×0.018 mm.

Locality. Seto, Tanabe Bay. Two colonies taken with lobster-nets.

Remarks. This is most related to *M. letourneuxi* (TIX.-DUR.) *M. elegantissima* (MAY) in arborescent form of growth, but can be easily separated from both in the shape and spiculation of tentacles and also in the peculiar shape of coenenchymal and cortical spicules.

6. *Sinularia gardineri* (PRATT)

(Fig. 6)

Sclerophytum Gardineri PRATT, 1903, p. 527, pl. 31, fig. 28; PRATT, 1905, p. 255.
Sinularia gardineri THOMSON & DEAN, 1931, p. 52, pl. 13, fig. 1 & pl. 22, fig. 4 & pl. 23, fig. 8; MACFADYEN, 1936, p. 34, text-figs. 3–4, pl. 5, fig. 2; TIXIER-DURIVAULT, 1945, p. 245.

Nom. Jap. Siba-katatosaka (nom. nov.).

A flat, low-growing colony, with a spread of 5×4 cm and a height of 2–2.5 cm, closely resembles MACFADYEN's photo of this species in her Great Barrier Reef report (1936, pl. V, fig. 2) in the form of growth, although the shape of cortical spicules is not exactly identical. Upon the flat capitulum delimited from a short sterile stalk around the edge, arise a number of short, scarcely branched lobes; the average length of main lobes is about 10 mm in the centre and 5 mm near the edge. The color is creamy white, and the texture is hard and brittle. The autozooids are fully retracted and very inconspicuous. There is no siphonozooid.

Cortical spicules in the stalk and lobes are similar in shape and size. They are typical clubs, about 0.17×0.07 mm ~0.22×0.1 mm, which are short, with 4 large compound warts around the head and a few smaller ones around the shaft; the central one at the tip of head as shown in MACFADYEN's specimens is not encountered. Coenenchymal spicules are all plump spindles with large compound warts, measuring

Fig. 6. *Sinularia gardineri* (PRATT).
a–b, Coenenchymal spicules; *c–e*, cortical spicules.
(All ×100)

0.5×0.3 mm, 0.8×0.3 mm, 1.5×0.47 mm and 2.0×0.5 mm.

Locality. Off Minabe, dredged from a depth of 100–200 m. One specimen, April 1938, S. SAKAGUCHI coll.

Previously recorded from Red Sea, Indian Ocean (Maldive Is., Gulf of Manaar, S. of Malha, Seychelles Is.), East Indies, Great Barrier Reef (Low Isles).

Remarks. This is a shallow water form principally living in the Indo-Pacific coral reefs. Therefore, the finding of this species in deeper waters of Japan is worthy of note.

7. *Sarcophyton acutangulum* (MARENZELLER)

Nom. Jap. Umitake.

The occurrence of this species in the Kii coast was reported only briefly (UTINOMI,

1953, p. 155). An example from Kii-ôsima is 25 mm high, with the capitulum about 40×55 mm in spread. Another young colony from Seto is a thick, mushroom-shaped type of a dark grey color.

Localities. Kii-ôsima, 5 m; Seto, Tanabe Bay, 15 m.

8. *Sarcophyton elegans* MOSER

(Fig. 7)

Sarcophyton elegans MOSER, 1919, p. 252, text-fig. 11, pl. 5, fig. 9; ROXAS, 1933, p. 380, pl. 1, fig. 9; MACFADYEN, 1936, p. 42.
Sarcophytum convolutum THOMSON & DEAN, 1931, p. 63, pl. 11, fig. 7 & pl. 23, fig. 1.
Sarcophytum elegans TIXIER-DURIVAULT, 1946, p. 86.

Nom. Jap. Hira-umitake (nom. nov.).

A large colony recently dredged from Tanabe Bay can be referred to this species. It shows the thin-margined, irregularly folded disc distinctly delimited from the cup-shaped low stalk. The marginal folds are broader than high and the centre of the disc is not much lower than the edge. It stands about 6 cm in height; the disc has a maximum diameter of 18 cm and the stalk a basal diameter of about

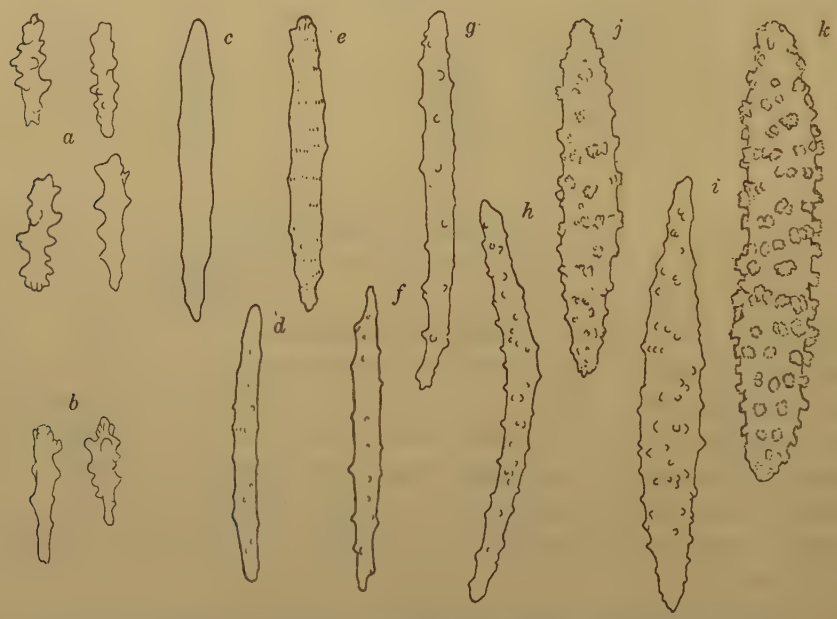

Fig. 7. *Sarcophyton elegans* MOSER.
a, Warty rods of stalk cortex; *b*, pseudo-clubs of disc cortex; *c–g*, slender spindles of disc interior covered with minute warts, sometimes zoned or often unwarted as in *c*; *h–i*, the same of stalk interior covered with simple warts: *j–k*, larger spindles of stalk interior covered with more or less compound warts. (*a–h*, ×150; *i–k*, ×100)

5–6 cm. When living, the disc is wholly purplish brown and the stalk ochre-yellow with numerous longitudinal striation of purple color which owes to the abundance of zooxanthellae contained within the endoderm.

The majority of the autozooids are fully expanded up to 5 mm in length. They are 2–3 mm apart at the edge of the disc and 5–8 mm apart in the centre. There are on the average 7–10 siphonozooids between two autozooids. The tentacles of autozooids have 8 pairs of short pinnules and bear densely packed numerous, simple or scarcely warted, rodlike spicules. Similar spicules are arranged transversely on the stalk of polyps, though not so thickly set as in the head.

The spiculation agrees closely with THOMSON & DEAN's description of *S. convolutum* which is synonymous with *S. elegans*. The spicules consist of three forms. Cortical spicules in the stalk as well as the disc are small warty rods, sometimes clublike in form, being broader and more warty at one end; they are about 0.08×0.023 mm, 0.09×0.03 mm and 0.1×0.023 mm. In the disc interior are slender and much longer spindles covered with relatively few tiny warts which are often zoned or entirely lacking; they are about 0.3×0.02 mm, 0.35×0.028 mm and 0.4×0.02 mm. Towards the base the coenenchymal spicules tend to much larger and to bear stronger, simple or compound, warts, up to 0.8×0.12 mm.

Locality. Entrance of Tanabe Bay, 30 m. One specimen, July 24, 1954.

Previously recorded from East Indies, Philippines, Great Barrier Reef and Madagascar.

9. *Lobophytum batarum* MOSER

(Fig. 8; Pl. I, Fig. 4)

Lobophytum batarum MOSER, 1919, p. 268, text-fig. 14, pl. 6, fig. 13; ROXAS, 1933, p. 362.

Nom. Jap. Hai-unetake (nom. nov.).

Five large, complete or incomplete, dry specimens are contained in the collection. The largest one among complete specimens measures 20×14 cm in spread of the disc. The stalk is much constricted and slightly widened apically, so that its accurate height cannot be measured, but approximately 3–5 cm long at the constricted state. The texture of the colony is very hard, and the color is brownish white, but darker in alcohol.

The disc is flattened, with a number of radially arranged, but not reaching the middle, high folds of rather even thickness (5–10 mm wide); the folds are often divided into high or low lobes at the tip up to 3 cm high, but not prolonged into digitiform processes. On these the autozooids are closely set, and between two autozooids lies only one row of small siphonozooids. Cortical spicules are simple spindles or somewhat club-like with warty heads, mostly about 0.14×0.04 mm to 0.25×0.05 mm. In the stalk interior are all warty spindles on the average 0.25 to

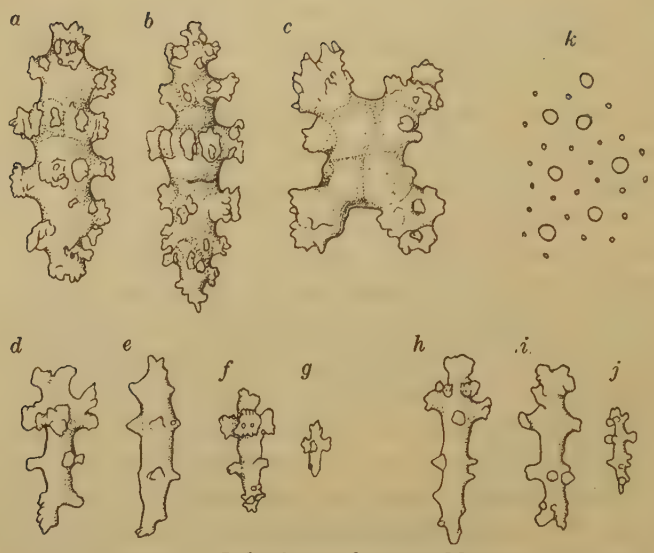

Fig. 8. *Lobophytum batarum* MOSER.
a–c, Spicules from coenenchyma of base; *d–g*, from cortex of base; *h–j*, from coenenchyma of capitular disc; *k*, part of disc, showing the arrangement of auto- and siphonozooids.
(*a–j*, ×150)

0.3 mm long and 0.07 to 0.085 mm wide, covered with heavy warts arranged in 4 to 6 distinct whorls; crosses may also be found.

Three of the colonies harbour on the capitulum a number of the epizoic barnacle apparently like *Acasta fenestrata* DARWIN which occurs usually on *Discodermia*-like lithistid sponges.

Locality. Kii-ôsima. Five dry specimens, July 17, 1939, S. SAKAGUCHI coll.

Hitherto known only from Philippines.

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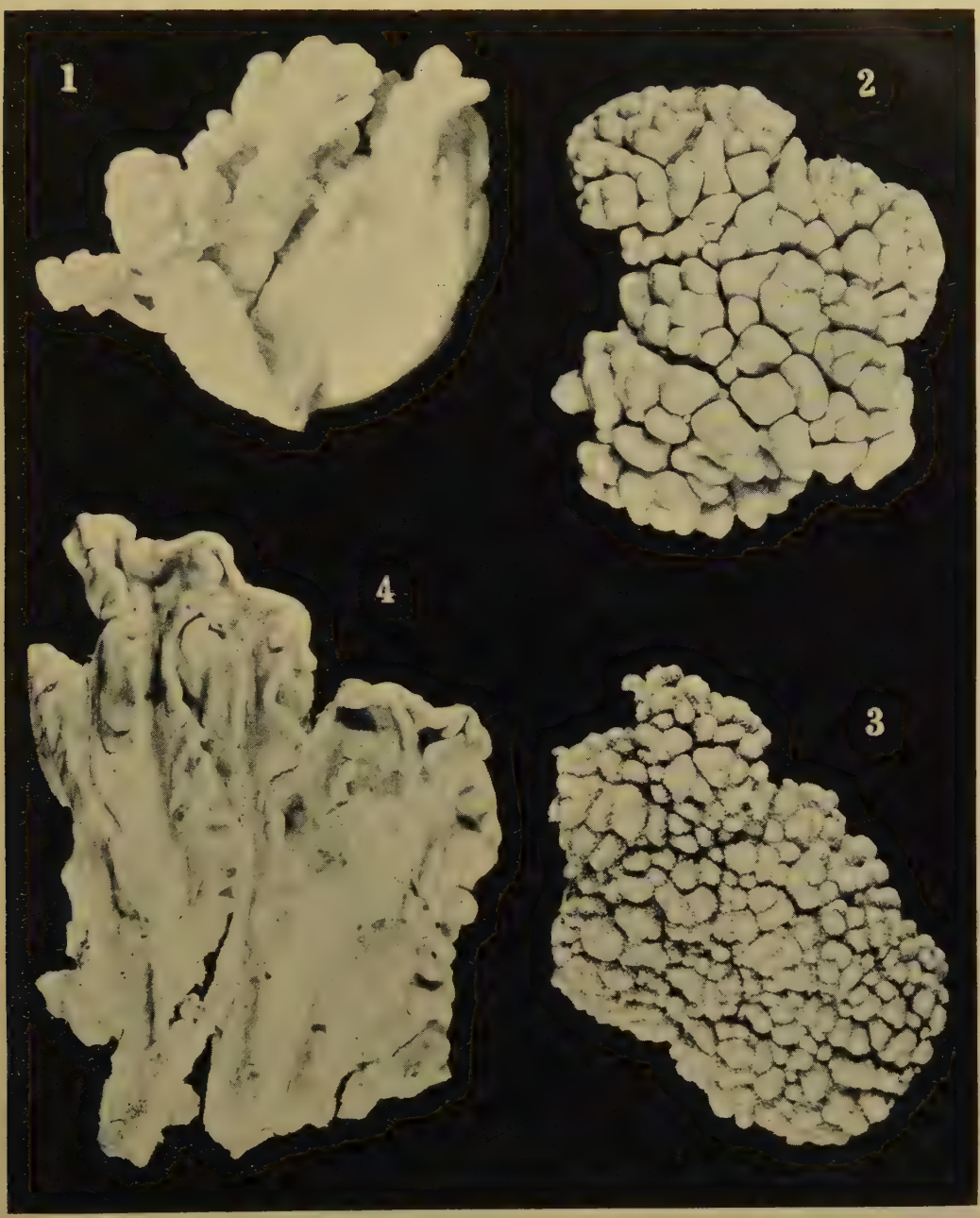
EXPLANATION OF PLATE I

Fig. 1. *Microspicularia arborea* n. sp. (Holotype) ×2/3.
Fig. 2. *Microspicularia digitulata* (KLUNZINGER), polyps retracted. ×1/2.
Fig. 3. *Microspicularia digitulata* (KLUNZINGER), polyps partially expanded. ×1/2.
Fig. 4. *Lobophytum batarum* MOSER. ×1/2.



H. Utinomi: Some Alcyoniid Octocorals from Kii Coast.

SOME NEPHTHEID OCTOCORALS FROM KII COAST, MIDDLE JAPAN[1)2)]

Huzio UTINOMI
Seto Marine Biological Laboratory, Sirahama

With Plate II and 6 Text-figures

The present paper is a continuation of the study of octocoral fauna around the Kii coast and concerned with a collection of the Nephtheidae (Nephthyidae), exclusive of the genera *Dendronephthya*, *Stereonephthya* and "*Eunephthya*" (=*Capnella*) which have already been published. The material so far obtained comprises a new species of *Litophyton* (*Lithophytum* auct.) and five known or unknown species of *Nephthea* (*Nephthya* auct.). All of them are recorded here for the first time from Japanese waters.

As to the nomenclature of both the genera *Litophyton* and *Nephthea*, I follow an opinion expressed by Roxas (1933) that any emendation of spelling of older names as has been done by Ehrenberg, Kükenthal and most later workers is unnecessary and is not required by any rules of nomenclature, even if linguistically incorrect, and it is to be hoped that this decision will be generally accepted. Hence, the family name Nephthyidae Verrill should be replaced by Nephtheidae in favour of the oldest generic name *Nephthea*.

1. *Litophyton viscidum* n. sp.

(Fig. 1; Pl. II, Fig. 5)

Nom. Jap. Numeri-tosaka (nom. nov.).

A single colony of the holotype was found growing on the back of a sponge crab *Dromidia unidentata* (Rüppel), which usually carries a monoascidian in our seas. Thus, the stalk of the colony is deeply hollowed out at the base and broadly flattened to form a capitulum at the top from which arise numerous fingerlike lobes. The capitulum shows a spread of 8×6 cm and the stalk with a height of about 2.5 cm slopes outwards to the edge of the capitulum. The lobes, crowded towards the edge, are

1) Contributions from the Seto Marine Biological Laboratory, No. 238.
2) Supported by a grant in aid for fundamental scientific research from the Ministry of Education.

generally short and divide into smaller, conical, secondary and tertiary branches, up to about 10–15 mm in total length and 5–15 mm in basal diameter at the contracted state. Polyps are uniformly arranged all over the lobes and on the capitulum, though scarcely at its centre.

Polyps are non-retractile, tubular, about 0.65 mm high and 0.45 mm in diameter. Tentacles are about 0.3 mm long and 0.1 mm wide at base, and provided with three blunt-ended pinnules on either side, which are longer distally. Spicules are absent from polyp body and tentacles.

The stalk is rigid, with thick canal-walls densely filled with short robust spindles with low warts, bluntly pointed at both ends, about 0.18–0.2 mm long and 0.03 mm

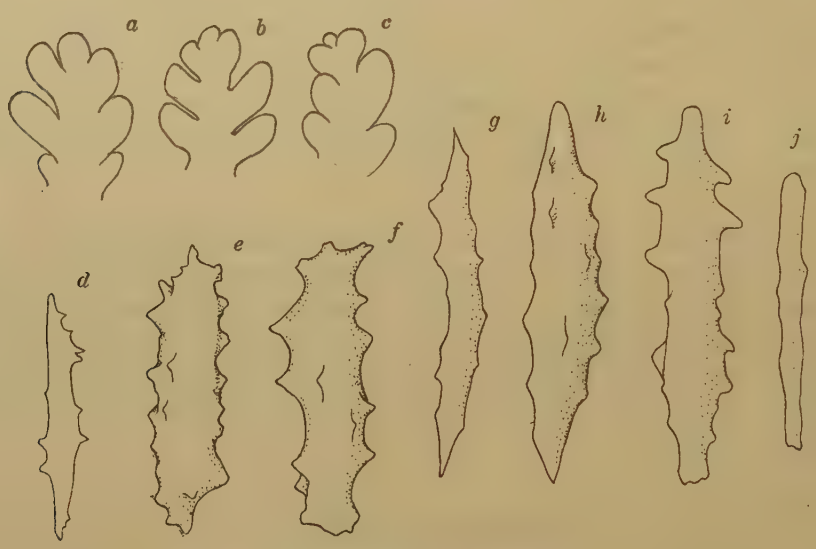


Fig. 1. *Litophyton viscidum* n. sp.
a–c, Tentacle; *d–f*, spicules from stalk coenenchyma; *g*, from cortex of lobes; *h*, from stalk cortex; *i–j*, from coenenchyma of lobes and branches.
(*a–c*, ×55; *d–f*, ×210; *g–j*, ×335)

wide. In the stalk cortex are straight spindles, scarcely warted, with almost similar size to those of the interior. The capitular surface and branch cortex are sparsely scattered with slender spindles, about 0.1×0.016 mm～0.15×0.008 mm. The canal-walls of the lobes contain a few straight, slender rodlets, about 0.065–0.16 mm long and 0.008–0.01 mm wide, smooth or slightly warted.

In life the colony is light brown in color, and flabby and very slimy to the touch. Hence the specific name.

Another small colony, from the same locality, with a spread of 4.8×4.1 cm and a height of 2 cm, shows a similar mode of growth, but lies on oyster shells.

Locality. Seto. Two specimens, November 9, 1950, T. YAMAMOTO coll.

Remarks. This species rather approaches the genus *Lemnalia* in its external appearance and in the dense spiculation in coenenchyme. The arrangement of polyps and the slimy texture of colony, place it in the genus *Litophyton.* Also the sclerites in the cortex and coenenchyme are all sparsely warted spindles peculiar to *Litophyton.*

2. *Nephthea chabrolii* AUDOUIN

(Fig. 2)

Nephthea chabrolii AUDOUIN, Expl. pl. Savigny, 1828, p. 49 (repr. by SHANN, 1912, p. 511, pl. LXI, figs. 1–5 & pl. LXII, fig. 6).
Nephthya chabrolii KÜKENTHAL, 1903, p. 157 (with synonymy).

Nom. Jap. Tizimi-tosaka.

Six colonies of light brown color preserved in alcohol agree well with this well-known species. The majority of them are 5–10 cm long, with a polyparium expanse of about 3–8 cm. From a short main stem arise 2–5 short stout branches which

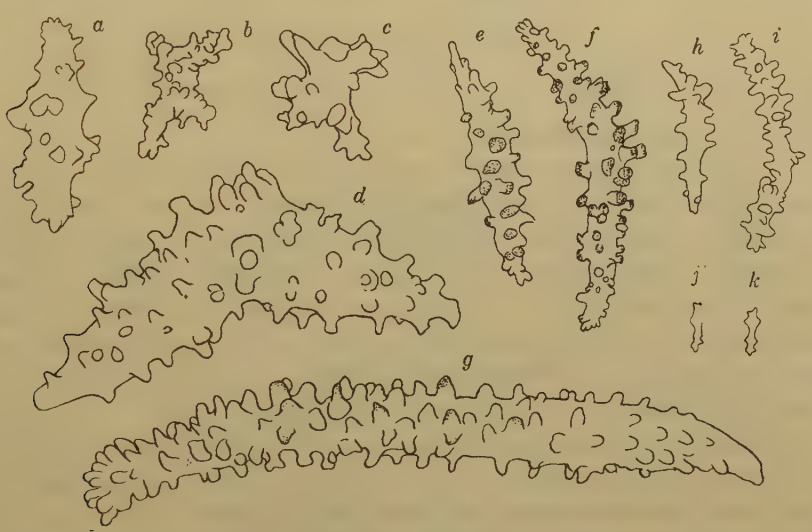


Fig. 2. *Nephthea chabrolii* AUDOUIN.
a–d, Spicules from stalk cortex; *e–f*, from cortex of lobes; *g*, from supporting bundle of polyp; *h–i*, from lateral side of polyp; *j–k*, from inside of polyp. (All ×100)

may either subdivide or give off directly to lobes. Lobes conical, with round tip, about 5–10 mm long and 3–5 mm wide. Polyps closely set on lobes, their head about 0.5–0.7 mm high and 0.7–0.8 mm wide, borne at a right angle to polyp stalk, about 0.3–0.35 mm long.

Polyp spicules on the outside and lateral sides are heavily warted spindles, about 0.2–0.4 mm long and 0.045 mm wide; they are arranged in indistinct double rows, about 6–8 in a row and many tiny rods may occur upwards between them. Those

situated on inside are smaller, less-warted spindles, 0.08–0.1 mm long and 0.008–0.015 mm wide. S. B. spicules are slightly curved warty spindles, rather strong, up to 1.2 mm long and 0.13 mm wide, usually covered with much more warts towards the tip in stronger ones.

On upper cortex of stem and lobes are long, slender, warty spindles, about 0.2–1.0 mm long and 0.05–0.08 mm wide, with prominent warts jagged at tip. On basal cortex are heavily warted (though not jagged at tip), stout, curved spindles, tri- and quadriradiates, about 0.35–1.0 mm long and 0.08–0.2 mm wide; besides smaller irregular forms about 0.08–0.2 mm across may be found. In canal-walls are similar spindles and irregular thorny forms.

Localities. Seto. Three specimens; Kii-ôsima. Six specimens, September 5, 1934.

Previously recorded from Red Sea and Pacific Ocean (East Indies, New Guinea, China Sea and Philippines), but not from Japan.

3. *Nephthea crassa* KÜKENTHAL

(Fig. 3; Pl. II, Fig. 2)

Nephthya crassa KÜKENTHAL, 1903, p. 167, pl. VIII. fig. 16 & pl. IX, figs. 61–62.

Nom. Jap. Numeri-tizimitosaka (nom. nov.).

Apart from the mode of growth, six specimens from the same locality seem to agree with KÜKENTHAL's *N. crassa*, especially in spiculation. The colony is composed of several stems of different sizes, which arise directly from a common base. Largest one of the main stems attains about 7 cm in total height and 4 cm in diameter at the base. Sterile stalk is rigid, fleshy, and longitudinally striated. It gives off numerous branches at different levels on which the lobes are situated. Lobes are somewhat rounded cone, not definitely longer than wide except the larger terminal ones, the majority being 2–3 mm long and 2 mm wide.

Polyps club-shaped, very small, about 0.35–0.7 mm wide, with a very short stalk. Polyp spicules are rather irregularly arranged in rows; they are very thorny spindles with high warts, about 0.08–0.2 mm long. S. B. spicules never projecting and not much different from spicules on lateral sides in form and size. Cortex of lobes is covered densely with many small stars, double-stars or irregular-formed thorny spicules, about 0.05–0.17 mm (on the average 0.1 mm) in diameter. On lower cortex of stem are similar spicules. In canal-walls are plump spindles with sparsely set blunt-ended warts, measuring 0.2×0.04 mm, 0.3×0.06 mm, 0.38×0.07 mm and 0.4×0.08 mm; interior of lobes lacks spicules.

In life, the colony is plumberous brown in color owing to the occurrence of zooxanthellae in endoderms, and very slimy to the touch.

An epizoic barnacle *Acasta alcyonicola* is found embedded in the stalk[1]

1) In describing this barnacle, the host was provisionally named as "*Capnella* sp.".

(UTINOMI, 1953).

Localities. Kusimoto. Five specimens taken with lobster-nets, January 29, 1952 and December 6, 1953, T. YAMAMOTO coll.

Ezura, Tanabe Bay. One specimen taken with lobster-nets, April 30, 1951, T. YAMAMOTO coll.

Previously recorded from Port Denison (Australia).

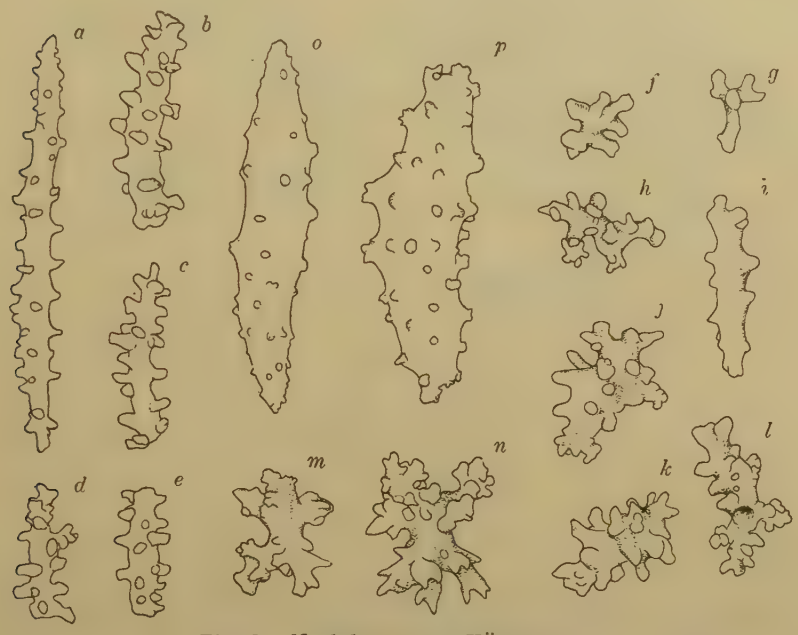


Fig. 3. *Nephthea crassa* KÜKENTHAL.
a–e, Spicules from polyp; *f–l*, from upper cortex; *m–n*, from basal cortex; *o–p*, from stalk coenenchyma. (All ×150)

4. *Nephthea erecta* KÜKENTHAL

(Fig. 4; Pl. II, Fig. 3)

Nephthya erecta KÜKENTHAL, 1903, p. 154, pl. VII, fig. 8 & pl. IX, figs. 45–47; THOMSON & DEAN, 1931, p. 85.
Nephthea erecta ROXAS, 1933, p. 410.

Nom. Jap. Tati-tizimitosaka (nom. nov.).

All the colonies are low, bushy in form and show the maximum height of 9 cm. From a membranous base arise several main stems giving off 2–5 branches upwards which give rise to many polyp-bearing twigs or lobes. Each lobe is generally elongate conical, 3–9 mm long and 2–3 mm wide, and bears small polyps all over the surface, though not closely packed.

Polyp head inturned, oval in lateral view, about 0.6–0.7 mm long and 0.5–0.6 mm wide, with a stalk less than 0.3 mm long. Polyp armature consists of 8 chevroned rows of narrow spicules, the number of which in each row cannot de definitely counted. S. B. of the entheathing type, composed of slender spindles with high prominent warts, about 0.6–0.8 mm long and 0.047 mm wide, which do not extend beyond

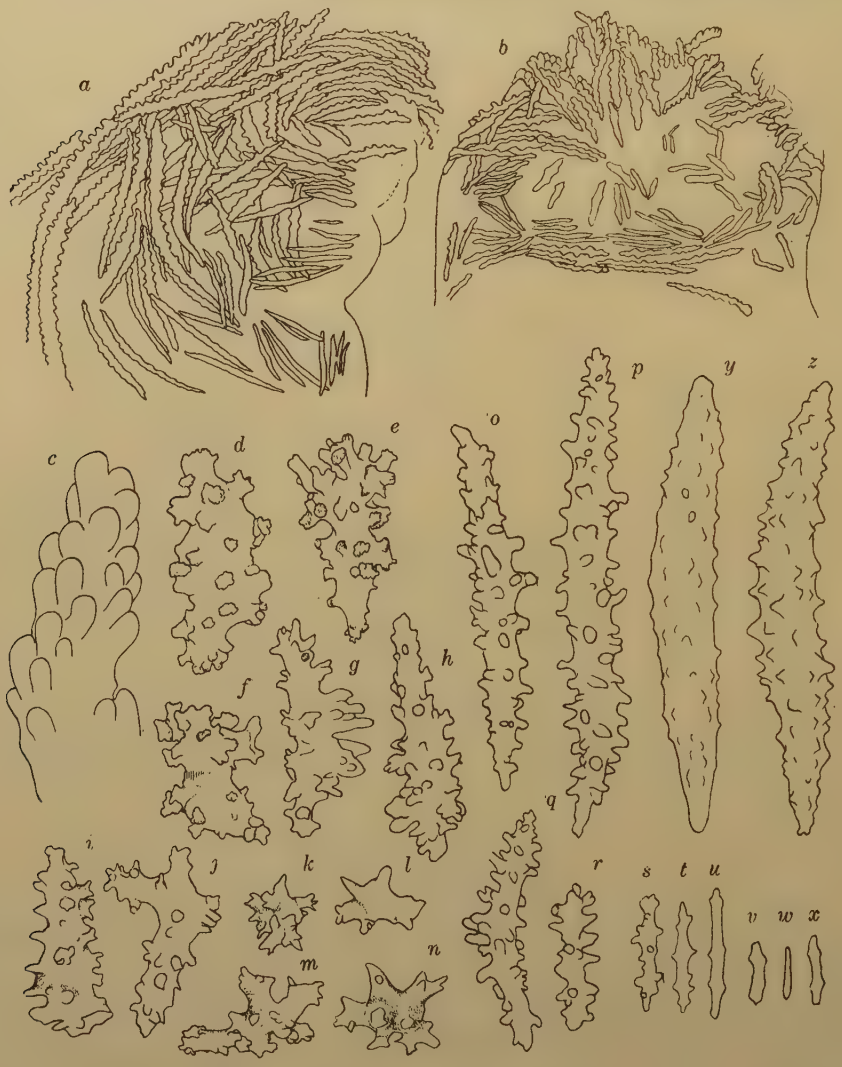


Fig. 4 *Nephthea erecta* KÜKENTHAL.

a, Polyp, lateral side; *b*, polyp, oral side; *c*, polyp-bearing lobe; *d–h*, spicules from upper cortex; *i–m*, from basal cortex; *o–p*, from supporting bundle of polyp; *q–r*, from outer side of polyp; *s–u*, from lateral side of polyp; *v–x*, from inner side of polyp; *y–z*, from canal-walls.

(*c*, ×6; *a–b*, ×55; *d–z*, ×100)

polyp head. On the inside of polyp stalk smaller, narrow rods, either smooth or slightly warted, about 0.06–0.09 mm long and 0.01 mm wide, are transversely arranged just below smaller point spicules of polyp head; they spread round the lateral sides and then the supporting bundle, measuring about 0.1–0.25 mm long and 0.015–0.02 mm wide on lateral sides.

On cortex of lobes and branches are mostly very thorny spicules of irregular shape, including straight or curved, warty spindles, slightly foliate or irregularly knobbed club-like forms, about 0.17–0.23 mm long and 0.12–0.14 mm wide, while on the basal cortex are mostly smaller star-shaped or irregular bodies with a diameter of 0.05–0.25 mm. Besides, a few larger stout spindles with prominent warts up to 0.8×0.15 mm may be found. In canal-walls are found only weakly warted spindles up to 1.5 mm long, but the majority are smaller, about 0.3–0.5 mm long and 0.05–0.06 mm wide, with low conical warts.

In life, the colony is not slimy and is dark greyish brown in color. Specimens in spirit are, however, creamy white.

Localities. Kii-ôsima. Eight specimens, September 5, 1934.

Kusimoto. Two specimens, December 6, 1953, T. YAMAMOTO coll.

Previously recorded from Tonga Islands, East Indies and Philippines.

5. *Nephthea capnelliformis* THOMSON & DEAN

(Fig. 5; Pl. II, Fig. 4)

Nephthya capnelliformis THOMSON & DEAN, 1931, p. 90, pl. X, fig. 1 & pl. XXIII, fig. 7.

Nom. Jap. Daruma-tizimitosaka (nom. nov.).

About ten flaccid colonies from the same localities are generally small, low, bushy in form and greenish brown in color. The surface of the colony is rather rough to the touch.

From a low flattened base several short stems arise. These give off very short branches on which the lobes are situated. Lobes are rather rounded conical, about 5 mm long and 3 mm wide and carry many small polyps closely crowded together. Polyps are very small, oval in lateral view and curved inwards. Polyp stalk very short and rather broader than head, so that not definitely demarcated between them. Polyps, head and stalk altogether, are on an average 0.8–0.9 mm long and 0.5–0.6 mm wide.

Polyp armature is very dense on the outer side of head and round the stalk, numerous slender strongly-warted curved spindles or pseudoclubs being arranged radially. Spicules on the outer (abaxial) side of polyps including those forming the supporting bundle are generally large, about 0.15×0.02 mm~0.45×0.05 mm, covered with prominent warts which are larger on outside than on inside, They are sometimes arranged indistinctly in double rows, about 6 or 7 in a row. Those on the inner

(adaxial) side are much smaller, rather smoother forms, at most 0.7×0.07 mm. They are very few in number in point rows. Those on the lateral side of polyp stalk are somewhat longer and transversely or obliquely arranged. Tentacular spicules are scale-like and slightly jagged at edges, about 0.09 mm long. Thus the polyp armature comes nearly close to that of the genus *Capnella*.

In cortex of upper branches are short spindles with prominent, simple, bi- or trifid warts, about 0.35×0.04 mm～1.1×0.08 mm. In lower cortex are slightly larger and stouter spindles or triradiates thickly covered with small conical warts, about

Fig. 5. *Nephthea capnelliformis* THOMSON & DEAN.
a, Polyp, lateral side; *b–d*, spicules from outer side of polyp; *e*, from tentacles; *f*, from inner side of polyp; *g*, from polyp stalk; *h–k*, from upper cortex; *l–m*, from stalk cortex; *n*, from canal-walls. (*a*, *l–n*, ×55; *b–k*, ×100)

0.6×0.1 mm～1.2×0.17 mm. In coenenchyme are pointed spindles densely covered with fine warts, measuring about 0.3×0.03 mm, 0.5×0.05 mm and 0.8×0.07 mm.

Localities. Entrance of Tanabe Bay, 10–30 m. Seven specimens, September 26, 1953, T. YAMAMOTO coll.

Kusimoto. Four specimens, December 6, 1953, T. YAMAMOTO coll.

Remarks. Younger shrubby forms appear somewhat different from the type, but a distinctly stalked example such as illustrated in Pl. II, Fig. 4, approaches nearly

closely to it in the mode of growth. The *Capnella*-like polyp armature, the ill-defined polyp stalk and also the general spiculation seem especially typical, though somewhat allied to those of *N. brassica* KÜKENTHAL from Tonga Islands and Philippines.

6. *Nephthea setoensis* n. sp.

(Fig. 6; Pl. II, Fig. 1)

Nom. Jap. Suginoha-tizimitosaka (nom. nov.).

A limp colony of a light yellowish green color, with a height of 8.5 cm, gives off numerous short branches on one side of the stem. The lobes on branches or directly issuing from the stem are elongate, though variable in length from 5 mm to 15 mm

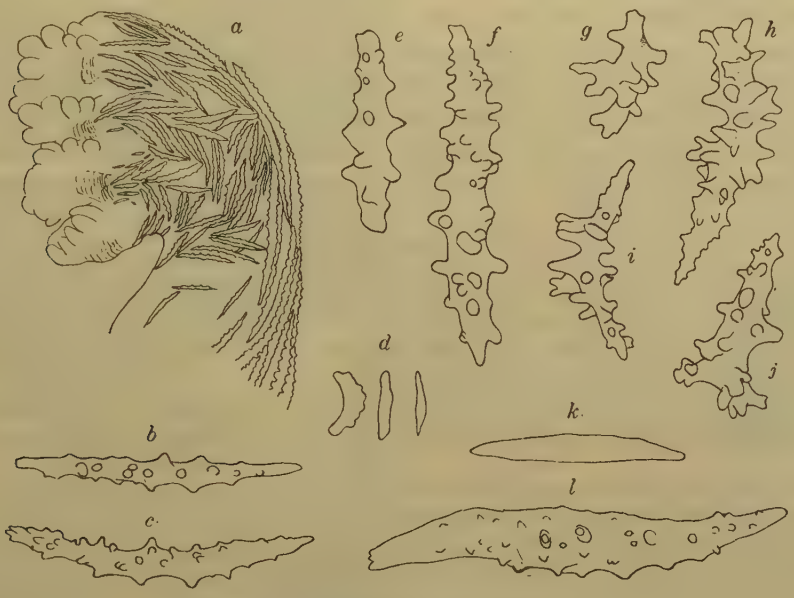


Fig. 6. *Nephthea setoensis* n. sp.
a, Polyp, lateral side; *b–c*, spicules from polyp; *d*, from tentacles; *e–f*, from upper cortex; *g–j*, from stalk cortex; *k–l*, from canal-walls.
(*a*, ×33; *b–l*, ×100)

and in width from 2 mm to 5 mm. Polyps are rather large, club-shaped, with incurved head which is borne almost at a right angle to the stalk; polyp head about 1 mm long and 0.7 mm wide, and polyp stalk about 0.6 mm long.

Polyp spicules are almost symmetrically arranged definitely in 8 double rows, 4 to 6 in a row. Spicules on the outside and lateral sides are slender spindles with low warts, about 0.3–0.45 mm long, while on the inside are somewhat smaller, smoother spindles, about 0.25 mm long. S. B. not developed, composed of many slender spindles with prominent warts, about 0.5–0.9 mm long (not over 1 mm long) and 0.05 mm

wide, and not protruding beyond polyp head. Tentacles about 0.55 mm long and 0.26 mm wide, with 7 pairs of pinnules on either side.

In upper cortex of branches are all spindles with round-tipped prominent warts, about 0.17–0.5 mm long and 0.03–0.06 mm wide. In lower cortex are short thorny spindles covered with very high warts, measuring about 0.17×0.035 mm, 0.5×0.07 mm and 0.75×0.09 mm. These sometimes lead to almost club-like or star-like, rough warty forms as derivatives of the spindle type. Canal-walls are filled only with spindles covered with less-prominent warts, less than 1 mm long, the majority being much smaller and smoother spindles as large as 0.2×0.03 mm, 0.3×0.035 mm and 0.55×0.08 mm.

An example of the barnacle *Acasta alcyonicola* UTINOMI mentioned above was also found embedded in the stalk of this species.

Locality. Ezura, Tanabe Bay. One specimen, April 30, 1951, T. YAMAMOTO coll.

Remarks. This specimen comes near *N. cupressiformis* KÜKENTHAL in the mode of growth and the general spiculation, but differs from it in the abundance of smooth spindles shorter than 1 mm in the canal-walls and in the symmetrically arranged point rows and non-projecting supporting bundle. *N. amentacea* STUDER also is probably an allied species.

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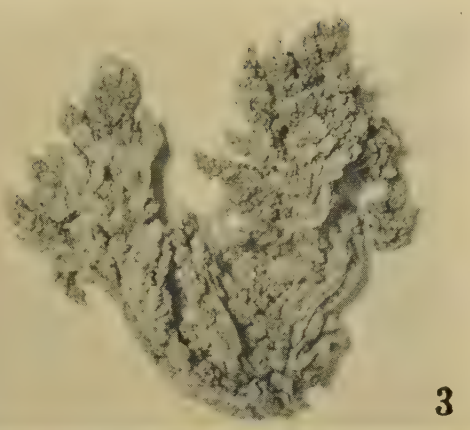
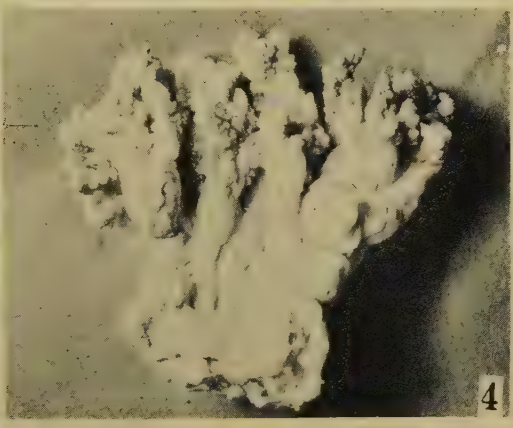
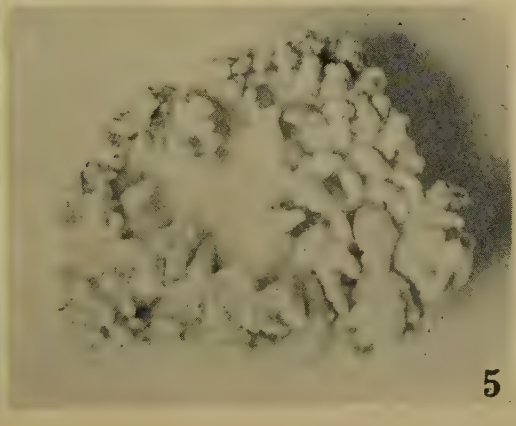
EXPLANATION OF PLATE II

Fig. 1. *Nephthea setoensis* n. sp. (Holotype) ×3/4.
Fig. 2. *Nephthea crassa* KÜKENTHAL. natural size.
Fig. 3. *Nephthea erecta* KÜKENTHAL. ×2/3.
Fig. 4. *Nephthea capnelliformis* THOMSON & DEAN. ×2/3.
Fig. 5. *Litophyton viscidum* n. sp. (Holotype) ×2/3.







H. Utinomi: Some Nephtheid Octocorals from Kii Coast.

CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA

VIII. SPORADIC MEMORANDUM (1)[1)]

TAKASI TOKIOKA
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With Plate III

Synoicum jordani (RITTER), 1899

Aplidiopsis jordani—RITTER, W. E. (1899): A contribution to the knowledge of the tunicates of the Pribilof Islands, Fur seals and fur-seal islands of the North Pacific Ocean, Pt. 3, p. 521, Figs. 19 and 20.

Macroclinum jordani—HARTMEYER, R. (1903): Fauna Arctica, Bd. III, pp. 322–324.
Synoicum jordani—VAN NAME, W. G. (1945): Bull. American Mus. Nat. Hist., Vol. 84, pp. 64–65.

A large nearly spherical colony was trawled by the Syunkotu Maru, a surveying ship of the Bureau of the Marine Investigations from the depths of Okhotsk Sea, shallower than 200 m, off the west coast of Kamtchatka, 54°07′ N×155°09′ E, on Sept. 1, 1937. The colony attached to the 75 mm long gastropod shell harbouring a large hermit crab is 125 mm in length, 115 mm in width, 75 mm in thickness and 870 gr. in weight.

It is pale purplish pink in colour and sprinkled with pinkish zooids. The surface is smooth and nearly free from foreign matters except for a small amount of sand grains and hydrozoan colonies on the basal portion which is somewhat harder than the other part of the colony. A few deep grooves divide the surface of the colony into several irregular areas. Test gelatinous, though rather hard. Zooids arranged in abundant systems consisting each of 7–10 zooids surrounding a common cloacal aperture and usually 5–7 mm in diameter.

Zooid: The largest zooid examined is 31 mm in length. Thorax strongly contracted in all examined zooids and flesh in colour. Abdomen about twice as long as contracted thorax. Postabdomen very long, may reach ca. 5 times as long as abdomen. No constriction between the thorax and the abdomen nor between the abdomen and the postabdomen.

1) Contributions from the Seto Marine Biological Laboratory, No. 239.

Thorax: Branchial aperture 6-lobed, atrial languet present, but very short in the contracted state. Rows of stigmata ca. 15; probably more than 15?

Abdomen: Stomach situated near the middle of the abdomen; globular in outline, smoothly surfaced and constricted very distinctly from both oesophagus and hind stomach. Middle intestinal portion very distinct, constricted clearly from other parts of the alimentary canal and passes to the rectum at the posterior end of the intestinal loop. The proximal part of the rectum is constricted distinctly but forms no coecum.

Postabdomen: About a dozen yellowish brown ova just behind the intestinal loop. A compact tissue nearly as long as the ovary and following it is considered to be the testis. Postabdomen is narrowed and becomes colourless for a short distance behind the testis, then thickened again posteriorly; this part is somewhat pinkish in colour and packed compactly with corpuscular cells.

Larva: A larva found in a zooid is about 1.1 mm in length of the trunk, the anterior part of which is somewhat narrowed. Attachment processes 2? Larval test sprinkled with many small patches of minute granules in the anterior half.

Remarks: A considerable number of species of *Synoicum* are reported by REDIKORZEV from Okhotsk Sea and the Sea of Japan. Of those, *S. jacobsoni* RED. and *S. derjugini* RED. resemble the present specimen most closely in the shape and appearance of the colony. However, both species differ distinctly from the present species in the appearance of the stomach which is provided with tubercular processes on the surface in the former. The specimen is deposited in the Biological Laboratory in the Imperial Palace, Sp. No. 120.

Distribution: Bering Sea and Bering Strait.

EXPLANATION OF PLATE III

Fig. A. *Synoicum jordani* (RITTER), total colony.
Fig. B. Four systems.
Fig. C. Zooid.
Fig. D. Larva. (×75)

T. Tokioka: Contributions to Japanese Ascidian Fauna, VIII.

CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA

IX. RE-DESCRIPTIONS OF OKA'S SPECIES FOUND IN "FIGURARO DE JAPANAJ BESTOJ"[1]

TAKASI TOKIOKA
Seto Marine Biological Laboratory, Sirahama

With Plate IV and one Text-figure

A. OKA (1927) gave brief descriptions of a number of ascidian species in "Figuraro de Japanaj Bestoj" under new names, each with an explanatory note "(仮)" at the end. This note indicates that the name is given provisionally without full description nor sufficient consideration on the identification. Some of these species were redescribed or some names were replaced with known ones by OKA himself, but eight species remain still untouched in the revised edition of the "Illustrated Encyclopedia of the Fauna of Japan" (1947); they are each marked with (MS) at the end of the name. I had chances to re-examine some type specimens or specimens identified by OKA himself and by this date I could give redescriptions of three species and found out that two are synonyms of the species already known to us. Here, the last three provisional species are redescribed each on the type specimen kept in the Zoological Institute of the Tokyo University of Education.

1. *Synoicum clavatum* (OKA), 1927

(Pl. IV, Figs. E and F)

Polyclinum clavatum (仮) OKA, A. (1927): Ascidiacea in "Figuraro de Japanaj Bestoj," p. 501, Fig. 965.
cit.: TOKIOKA, T. (1953): Ascidians of Sagami Bay, pp. 184–185.

Original description: Colony consists of several club-shaped cormidia united one another at the basal end, by which the animal attached to the substratum. Corona 27 mm in length and 19 mm in diameter, peduncle reaches as long as 37 mm. Surface of colony smooth; test soft, colourless and transparent; zooids can be seen through. Zooid slender, consists of thorax, abdomen and postabdomen; many zooids arranged parallel to the axis of the cormidium. Thin vascular canal issued from the posterior end of the postabdomen and reaches deep into the peduncle. Branchial

1) Contributions from the Seto Marine Biological Laboratory, No. 240.

aperture 6-lobed, a slender languet at the atrial aperture. Thorax and abdomen nearly equal in length. From 10 to 12 rows of stigmata on the thorax. Dist.—From the shallows along the Pacific coast of Honsyû.

Test is gelatinous, soft but sticky in consistency and slightly milky white in colour. System indistinct. The anterior part of the peduncle contains postabdomens of zooids, while the posterior part contains solely vascular prolongations of zooids.

Zooid: About a dozen thin longitudinal muscles on each side of the thorax. Several short transverse muscles behind the atrial aperture. Rows of stigmata 15–17. Tentacles ca. 15. Anus opens on the level from 10 to 12th transverse vessel, bilobed.

Abdomen: Stomach near the middle of the abdomen, roundish in outline and surfaced smoothly, though irregularly wrinkled in strongly contracted specimens. Mid-intestine distinct. Rectum begins near the posterior end of the intestinal loop and has no coecum at the proximal end.

Postabdomen: Very slender, 10–15 mm in length. Ovary situated just behind the intestinal loop. Testicular follicles arranged in 2 rows in the thicker anterior half, while in a single row in the thinner posterior half. The posterior portion contains no follicle but the heart at the rear end.

2. *Leptoclinides tigrinum* (OKA), 1927

(Fig. 1)

Didemnoides tigrinum (仮) OKA, A. (1927): Ascidiacea in "Figuraro de Japanaj Bestoj," p. 498, Fig. 960.
cit.: TOKIOKA, T. (1953): Ascidians of Sagami Bay, p. 15.
TOKIOKA, T. (1953a): Publ. Seto Mar. Biol. Lab., vol. III, No. 1, p. 2.

Original description: Colony irregular in shape, encrusting stems of sea weeds such as *Sargassum* and less than 2 mm in thickness. The surface of the colony nearly smooth and coloured yellow and black as in the fur of the tiger. Test soft and contains numerous stellate calcareous spicules. Zooids short, consists each of thorax and abdomen and situated perpendicularly. They are arranged in simple but irregular systems. Common cloacal apertures roundish in outline and scattered here and there. Four rows of stigmata which are short and straight. Dist.—From the shallows along the coast of Honsyû.

Colony usually less than 3 mm in thickness, although it reaches as thick as 5 mm where it encrusting both surfaces of leaves of *Sargassum*. Pale grayish brown in colour in preserved specimens. No pattern nor system found on the surface. All spicules are dissolved and leave whitish vestigeal spots scattered in the test. They are found sparsely in the layer containing zooids, but none in the superficial layer

where some traces of pigments are found and let us surmise the existence of the deep pigmentation in a fresh state. Judging from the size of the vestigeal spots, the spicules are considered to be considerably large.

Zooid: Average distance between zooids 760μ. Thorax 680μ and abdomen 900μ in length in an examined zooid.

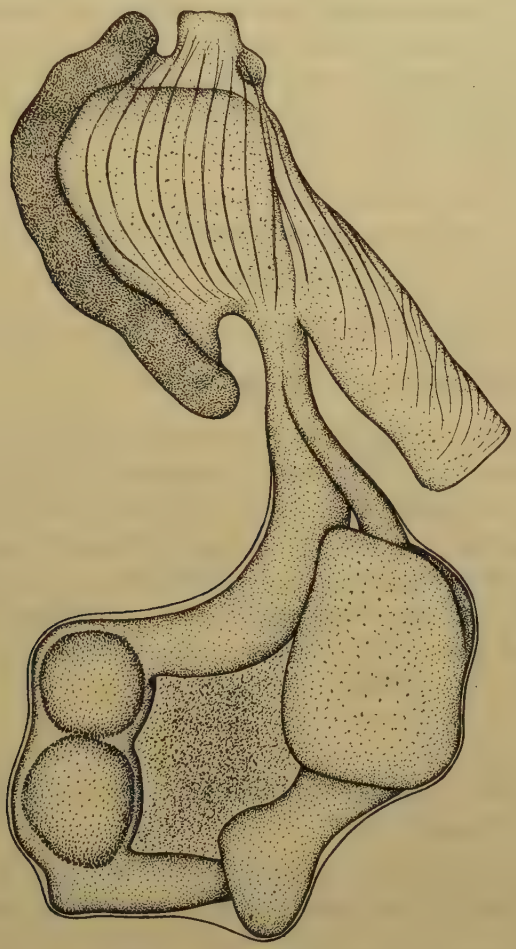


Fig. 1. *Leptoclinides tigrinum* (Oka). Zooid from left side, ×75.

Thorax: Atrial siphon situated at the dorso-posterior corner of the thorax, rather long and stretched posteriorly. About 10 longitudinal muscles on each side of the thorax. Tentacles ca. 8. Less than 8 stigmata in each of 4 rows.

Abdomen: Alimentary canal as in general species of Didemnidae. Testicular

follicles 4–12, most frequently 5–8; vas deferens coils 6 times at the proximal portion.

Remarks: *Leptoclinides komaii* TOKIOKA has much more, 20–24 testicular follicles and vas deferens coiling only once at the proximal end. *Leptoclinides ocellatus* (SLUITER) has usually 4, ranging from 4 to 7, testicular follicles and shows the characteristic pigmentation consisting of many small roundish pigment patches. *Leptoclinides madara* TOKIOKA bears regularly 4 testicular follicles and shows the pigment pattern very like the present species, although the pigmentation is in quite different hue. Thus, it is most possible that *Lept. madara* is synonymous with the present species if the difference in the colouration is proved to be of no specific importance. Even then, how it is regrettable that all the spicules of the type specimen are quite dissolved.

3. *Eudistoma parvum* (OKA), 1927

(Pl. IV, Figs. G–J)

Distoma parvum (仮)—OKA, A. (1927): Ascidiacea in "Figuraro de Japanaj Bestoj," p. 497, Fig. 958.
cit.: TOKIOKA, T. (1953): Ascidians of Sagami Bay, p. 15.

Original description: Colony consists usually of several small mushroom-shaped cormidia which consist each of a roughly hemispherical corona and a cylindrical peduncle. Cormidia are united one another at the basal end. Length of cormidium 10 mm, diameter of corona ca. 8 mm. Corona translucent, grayish in colour and contains zooids, while peduncle rather opaque, whitish and contains only vascular canals. Zooids comparatively large and composed of thorax and abdomen, the two parts are constricted from each other. Both apertures open directly to the outside on the surface of the corona and 6-lobed. Dist.—From the shallows along the coast of Honsyû.

The surface of the corona smooth; test soft, gelatinous, translucent and milky white in colour.

Zooid: Large one may reach as much as 5 mm in length in a contracted state. Abdomen 3 times as long as the thorax or more in perfectly preserved zooids.

Thorax: Large thorax 1.4 mm in length in a slightly contracted state. From 12 to 15 longitudinal and ca. 30 transverse muscles on each side. Eight to ten stigmata in each of 3 rows. Tentacles ca. 20, dorsal languets of moderate size and displaced slightly to the left side. Anus situated on the level of the second transverse vessel and with two thickened lips. Up to 2 embryos found in some zooids.

Abdomen: Stomach in the posterior part of the abdomen, globular in shape and smoothly surfaced. Mid-intestine distinct and occupies the posterior end of the

intestinal loop. No coecum at the proximal end of the rectum. Vas deferens fully packed with sperms. Gonads degenerated, except for a few testicular follicles in rare cases.

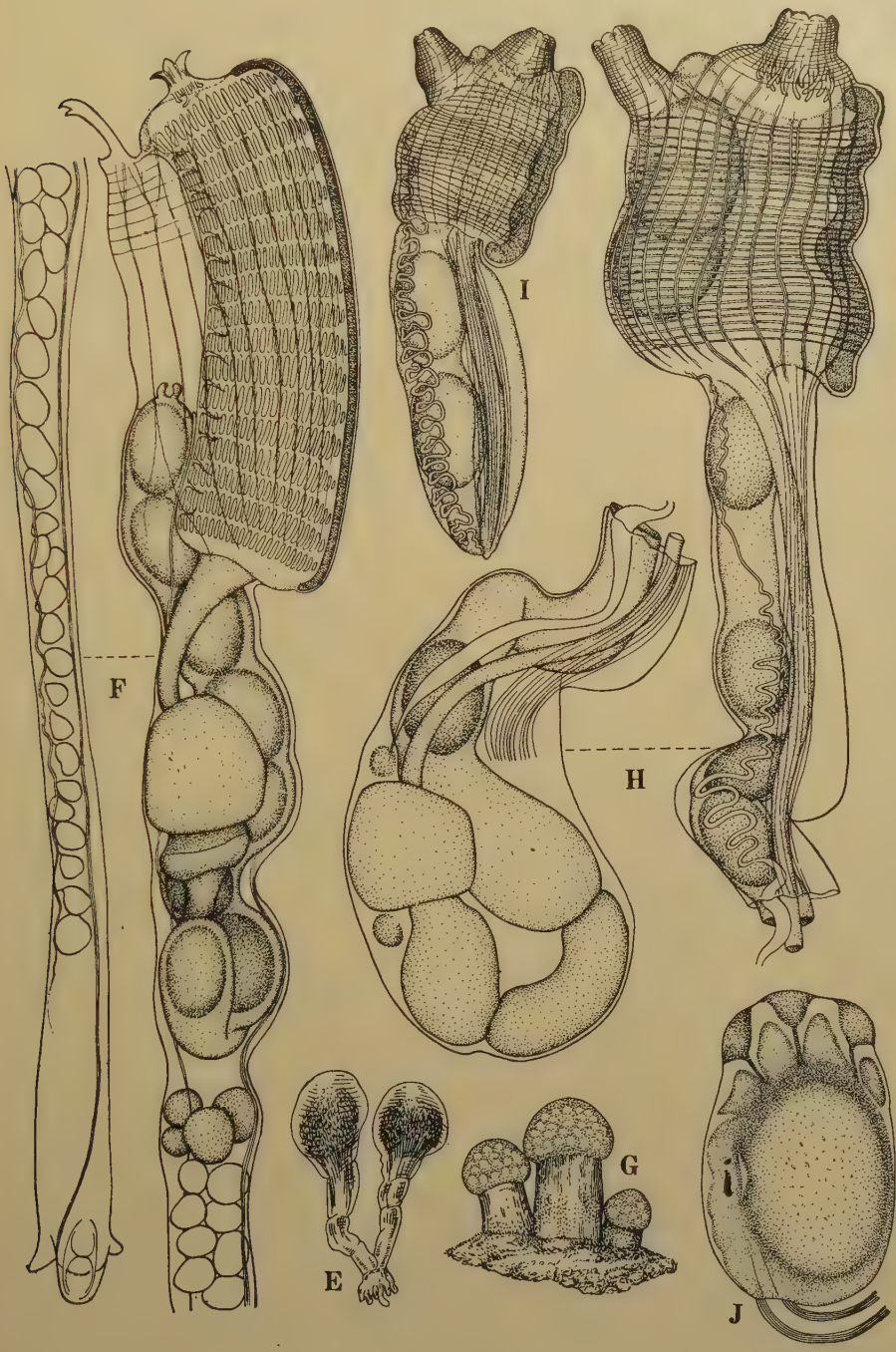
Larva: Trunk ellipsoidal, 550–560μ in length, 1.6–1.76 times as long as wide. Three cup-shaped attachment processes arranged linearly. Two pigment flecks of the sensory organ arranged antero-posteriorly; the posterior one is much larger than the anterior one, elongate in outline and brownish in colour, while the latter roundish in shape and pure black in colour.

Remarks: *Eudistoma rubra* TOKIOKA and *E. tokarae* TOKIOKA resemble closely the present species in the shape of the colony. In the first species, however, zooids are devoid of transverse muscles on the thorax. The second species conforms with the last one also in the arrangement of thoracic muscles. Differences are shown merely in the following three points: (1) *E. tokarae* is pigmented conspicuously on the thorax of the zooid, (2) in *E. tokarae* transverse muscles are united into several bundles along the dorsal side of the thorax, and (3) zooids of *E. tokarae* are small, less than 2.5 mm in length; this size is about a half of that of perfectly preserved zooids of *E. parvum*. Thus, it is not impossible that *E. tokarae* represents a younger colony of the present species.

Colonies of the type specimen contain only a small number of perfectly preserved zooids; most zooids are found in the state shown in Pl. IV fig. I, in which the abdomen is cut off in front of the stomach. The posterior part of the abdomen degenerates completely, while the anterior part, usually as long as the contracted thorax, remains unchanged. These zooids are completely devoid of gonad, but they seem to be functional as males, because the vas deferens is exceptionlessly filled with sperms and plays the rôle of the seminal vesicle. As some zooids contain well developed embryos in the incubatory chamber, the present species can be considered to be protogynous. It is quite unknown why zooids cast the posterior halves of their abdomens away, although the following two ideas, for instance, may be easily suggested: (1) Organs in the abdomen may be regenerated and the abdomen grows forwards after a pause for a little while; thus the prolongation of the peduncle is brought about; (2) this condition shows nothing but merely the state in which zooids serve as males; zooids may die after the ejection of sperms.

EXPLANATION OF PLATE IV

Figs. E–F. *Synoicum clavatum* (Oka)
E···Colony (from Oka, 1927).
F···Zooid, magnified.
Figs. G–J. *Eudistoma parvum* (Oka)
G···Colony (from Oka, 1927).
H···Zooid, magnified.
I ···Zooid casted the posterior half of the abdomen away, magnified.
J ···Larva, from right side, ×75.



T. TOKIOKA: CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA, IX.

CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA

X. NOTES ON SOME ASCIDIANS COLLECTED IN OSAKA BAY (2)[1]

TAKASI TOKIOKA
Seto Marine Biological Laboratory, Sirahama

With Plates V–VIII and 7 Text-figures

After the publication of my previous report (1951) on some ascidians of Osaka Bay, I have had chances to examine three ascidian materials, all collected by Mr. R. ISIBASI in the south-eastern part of Osaka Bay. Thus, the ascidian fauna of the Bay increased much in number as shown below:

	I	II	III	IV
	(TOKIOKA 1951)	(Collected in 1950·1951·1951–1952)		
1. *Amaroucium multiplicatum*			+	+
2. *Amaroucium pliciferum*			+	
3. *Didemnum* (*Didemnum*) *moseleyi*		+	+	
4. *Didemnum* sp.				+
5. *Leptoclinides nigrothorax* n. sp.		+		
6. *Leptoclinides echinatus* n. sp.			+	
7. *Distaplia dubia*	+		+	+
8. *Ciona intestinalis*	+		+	
9. *Ascidia alpha*		+		+
10. *Ascidia gamma* n. sp.		+		
11. *Ascidia zara*			+	
12. *Ascidia sydneiensis divisa*	+	+	+	+
13. *Botryllus perimigenus*				+
14. *Botryllus communis*	+		+	+
15. *Botrylloides violaceum*	+		+	+
16. *Symplegma reptans*	+			
17. *Polyzoa pacifica*	+			
18. *Cnemidocarpa areolata*		+	+	+
19. *Cnemidocarpa fertilis* f. *minor* nov.				+
20. *Cnemidocarpa macrogastra*		+	+	

1) Contributions from the Seto Marine Biological Laboratory, No. 241.

21. *Styela partita*	+	+	+	+
22. *Styela plicata*	+	+	+	+
22a. *Styela plicata* f. *tenuis*	+	+		
23. *Styela isibasii*	+			
24. *Styela clava*	+		+	+
25. *Pyura michaelseni*		+	+	+
26. *Pyura lepidoderma*		+	+	+
27. *Pyura mirabilis*				+
28. *Boltenia isibasii* n. sp.		+		
29. *Halocynthia roretzi*	+		+	
30. *Eugyrioides glutinans*	+		+	+
Number of species	14	13	19	17

Four new species and a new form are described here, besides some notes on other species already known. Before going further I with to express my hearty thanks to Mr. R. ISIBASI for his kindness in offering me these precious materials.

1. *Amaroucium multiplicatum* (SLUITER), 1909

(Pl. V, Fig. 1)

Aplidium multiplicatum—SLUITER 1909.
Amaroucium multiplicatum—TOKIOKA 1953.

Two colonies encrusting the stem of *Sargassum*, respectively 28 mm × 9 mm and 15 mm × 12 mm in extent and both 3–4 mm in thickness. Zooids orange in colour, 2.5 mm–3 mm in length in large ones, and form at some places irregular groups surrounding each a small round common cloacal aperture. Abdomen about two thirds of thorax, postabdomen as long as the rest of the body. Atrial languet of moderate size and ending simply. Eight to ten longitudinal muscles on each side of the thorax. Seven-eight rows of stigmata, each containing about a dozen stigmata. Anus bilobed and situated on the level of the 5th transverse vessel. About 15 plications on stomach. The proximal end of the rectum does not form distinct coeca as in SLUITER's description. Testicular follicles up to 20 in number in examined zooids.

Remarks: Some differences found between these colonies and those found in Sagami Bay can not be considered to be of specific significance. Collected from the coast of Kozima on June 20, 1951. There is a small colony encrusting *Styela plicata* found in the fourth material. This specimen was in rather poor state of preservation and I could only confirm the existence of 7–8 rows of stigmata on some zooids. *Am. californicum* RITTER & FORSYTH 1917 from the Californian Coast and especially *Am. accarense* MILLAR 1953 from the Gold Coast resemble very closely the present species.

2. *Amaroucium pliciferum* Redikorzev, 1927

(Pl. V, Figs. 2–5)

Amaroucium pliciferum—Redikorzev 1927; Tokioka 1953.
Amaroucium roseum—Oka, A. 1927.

One colony from Satomati-ura of Okinosima on May 6, 1951. It is 47 mm ×18 mm in extent and 15 mm in thickness. Test soft gelatinous; zooids reddish, darker on the thorax, especially around the apertures. They are ca. 10 mm in length; postabdomen as long as the rest of the body. Thorax with about 16 longitudinal muscles on each side. Rows of stigmata 13 on the left and 14 on the right, each comprising 12–16 stigmata. Anus situated on the level of the 10th transverse vessel. The outline of ciliated groove differs slightly from that described previously (Tokioka 1953) and forms a longitudinal slit, ca. 40μ in length. About 20 plications on stomach, distinct coeca at the proximal end of the rectum. Up to 6 eggs and embryos in the incubatory chamber, all coloured orange-red.

3. *Didemnum* (*Didemnum*) *moseleyi* (Herdman), 1886

(Fig. 1)

Leptoclinum moseleyi—Herdman 1886.
Didemnum moseleyi—Sluiter 1909, 1914; Van Name 1918; Tokioka 1949, 1953, 1954.
Leptoclinum album—Oka, A. 1927.

Three small colonies encrusting St. areolata from Minami-hama of Nagasaki on May 20, 1951 (A, D, G): They are respectively 7 mm×5 mm, 4 mm×3 mm and 8 mm ×2.5 mm in extent and all 1.5 mm in thickness. The colony grayish brown in colour and sprinkled with minute white spicules. They are distributed in the surface layer evenly, but not densely; the dark brownish inner matrix can be seen through the test. The lower layer below the middle stratum contains spicules very sparsely. Large spicules 37μ in diameter, with 7–8 rays on the equatorial plane. Average distance between zooids ca. 330μ. Thorax ca. 550μ and abdomen ca. 500μ in length. Thoracic tubercle indistinct. Testicular follicle 1.

A large colony found in the second material (B, C, E, F, H, I): It is encrusting the basal portion of *Ecklonia* sp., somewhat irregular in shape and as a whole pale grayish purple in colour; 80 mm×80 mm in extent in wide parts and 1–2 mm in thickness. Test translucent, pale yellowish brown in colour; whitish zooids and dark substratum are seen through. Zooids are arranged in irregular groups, each comprising 10–20 zooids; average distance between zooids in a group ca. 320μ. Spicules are distributed sparsely along the upper and lower walls of thoracic lacunae, but quite absent in thin superficial and thick bottom layers. Average diameter of common spicules 38μ, the maximum diameter 51μ. Granulated cells, up to 29μ in

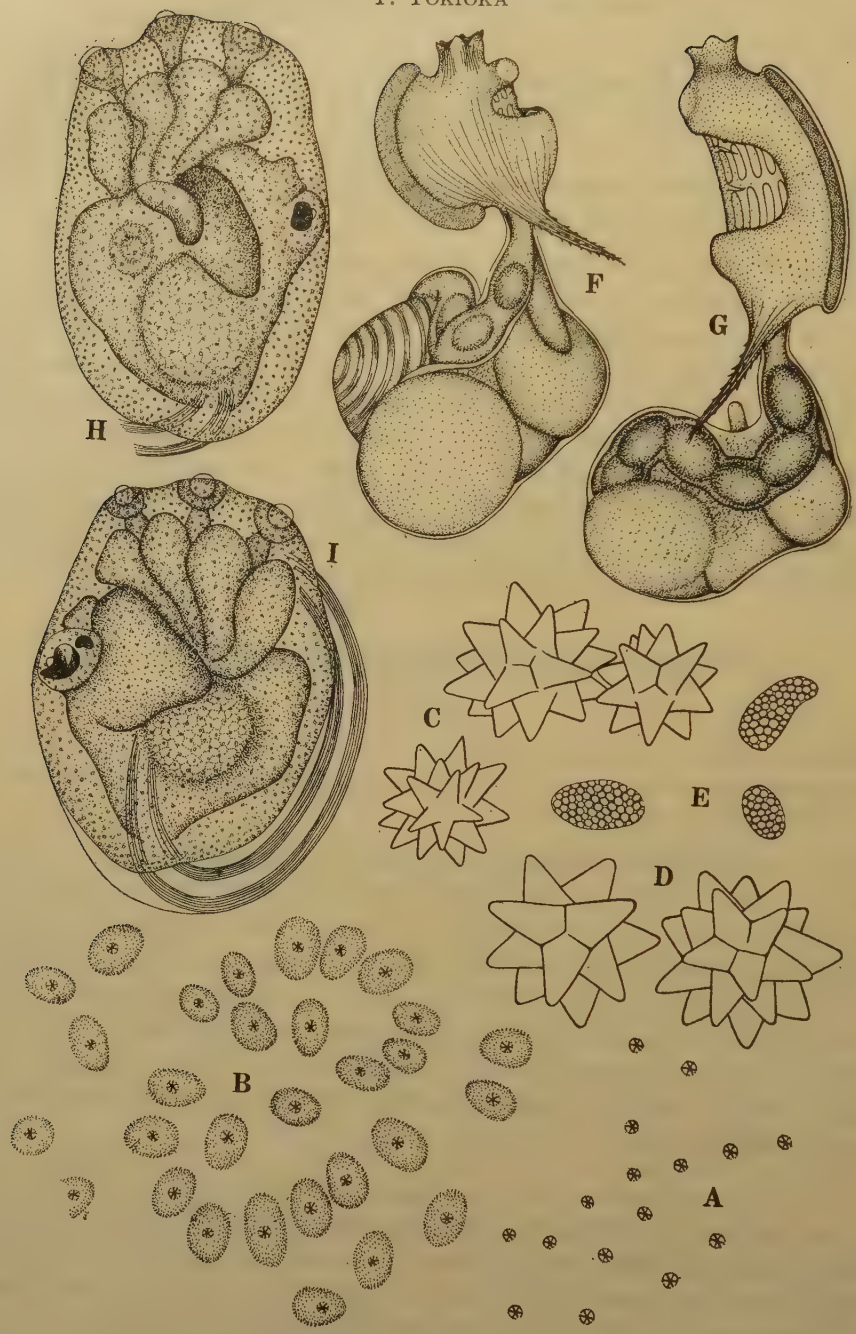


Fig. 1. *Didemnum* (*Didemnum*) *moseleyi* (HERDMAN).
A, D, G—small colonies from Minami-hama of Nagasaki. A—A part of the colony surface, ×25. D—Spicules, ×630. G—Zooid from right side, ×75.
B, C, E, F, H, I—large colony in the second material. B—A group of zooids, ×25. C—Spicules, ×440. E—Granulate cells, ×440. F—Zooid from left side, ×75. H—Larva from left side, ×110. I—Larva from right side, ×110.

length, are distributed throughout the layer containing spicules. Thorax 320μ long in contracted state and whitish in colour, abdomen ca. 500μ in length and yellowish orange in colour. Thoracic tubercle indistinct. About 6 stigmata in each row. Testicular follicle 1, proximal part of vas deferens coils 7–8 times. Trunk of larva 550μ in length on the average. Three attachment processes arranged linearly, ampullae 4 pairs; larval test granulated.

Remarks: These colonies may be safely identified as *Did.* (*Did.*) *moseleyi* in states showing somewhat peculiar distribution of spicules.

4. *Didemnum* sp.

(Pl. VI, Fig. 9)

Colonies encrusting *Styela plicata*. They are 18 mm×33 mm~27 mm×35 mm in extent in wide parts and less than 1 mm in thickness. Test transparent and slightly milky white in colour. The surface generally smooth, although some elevations and depressions occur irregularly. Common cloacal aperture quite obscure on the present material. Spicules absent.

Average distance between zooids 520μ. Thorax ca. 450μ long in contracted state, abdomen ca. 610μ in length. The anterior half of the thorax is pigmented in dark brownish colour, consequently branchial apertures are discernible distinctly as darkly coloured small circles. The alimentary canal is arranged as in common species of the genus *Didemnum* (*Didemnum*). Gonad immature.

The absence of the spicules and the existence of pigmentation in the anterior half of the thorax are the characteristics of the present specimens. However, it is hardly possible to identify the specimen decidedly at present, because thorases are all contracted strongly, abdomens are in rather worse condition of preservation and gonads are quite immature.

5. *Leptoclinides nigrothorax* n. sp.

(Pl. V, Figs. 6–8)

A small 9 mm×8 mm colony in the second material. It is 2 mm in thickness and has a layer of faecal pellets along the attachment surface. Test transparent; spicules are distributed very sparsely merely along the upper wall of the thoracic lacunae; a superficial spiculeless layer is discernible. Spicules usually ca. 45μ in diameter and very like those of *Did.* (*Did.*) *moseleyi*. There are many elongate granulated cells in the test, which may be 45μ long in larger ones. Average distance between zooids ca. 420μ.

Zooid: Thorax and abdomen respectively ca. 500μ in length. Thoracic mantle dark purplish black in colour. A short atrial siphon protrudes out at the postero-

dorsal corner of the thorax. Thoracic tubercle at the postero-ventral part of the thorax on each side, elliptical in shape and usually containing a dozen granules. Retractile muscle very small. About 6 stigmata in each of 4 rows; dorsal languets slender; tentacles ca. 12. Stomach and mid-intestine unpigmented, only the rectum is faintly pigmented. Gonad immature; several testicular follicles?

Remarks: The small size of zooids and the dark pigmentation of the thorax are the characteristics of the present new species. The former characteristic recalls to our mind the resemblance with *Polysyncraton nigropunctatum* SLUITER.

D. B. CARLISLE and A. I. CARLISLE (1954) abandoned the genus *Leptoclinides* and placed some species of the abandoned genus under *Polysyncraton*. I wish, however, to notice on the fact that there are distinct differences between species of *Leptoclinides* and those of *Polysyncraton* occurring in the north-western Pacific. Besides the existence of the atrial siphon in *Leptoclinides*, the existence of the atrial languet in *Polysyncraton* and the situation of the ovary on the testis in the same subgenus are considered to be noteworthy. Thus I prefer to retain the opinion of separating *Leptoclinides* from *Polysyncraton* till further crucial studies are completed.

6. *Leptoclinides echinatus* n. sp.

(Fig. 2)

A 45 mm × 30 mm colony encrusting the barnacles caught in the net at the northern side of Okinosima on June 10, 1951. It is 1–2 mm in thickness and encloses a *Musculus* sp. in a part of the test which is rather tough, pale grayish yellow-brown in colour, with irregular pale reddish orange pattern and sprinkled with many white dots representing zooids. There are many finger-shaped or slender triangular protuberances on the surface. Spicules distributed evenly but very sparsely throughout the test, except for the superficial layer which is quite devoid of spicules. They are 40μ in diameter in larger ones and have each up to 10 rays on the equatorial plane. The appearance of rays resembles closely that of *Did.* (*Did.*) *moseleyi*. Reddish-orange colouration of the test is due to the pigmentation found just below the superficial spiculeless layer.

Zooid: Average distance between zooids 590μ. Thorax 860μ and abdomen 910μ in length in an examined zooid. A small roundish thoracic tubercle is found near each postero-lateral side of the basal portion of the short atrial siphon projecting out from the postero-dorsal corner of the thorax and contains granules within it. Testis very large, occupying the whole lateral side of the abdomen. Testicular follicles number from 4 to 12, most frequently ca. 10. The proximal end of vas deferens coils 6–7½ times.

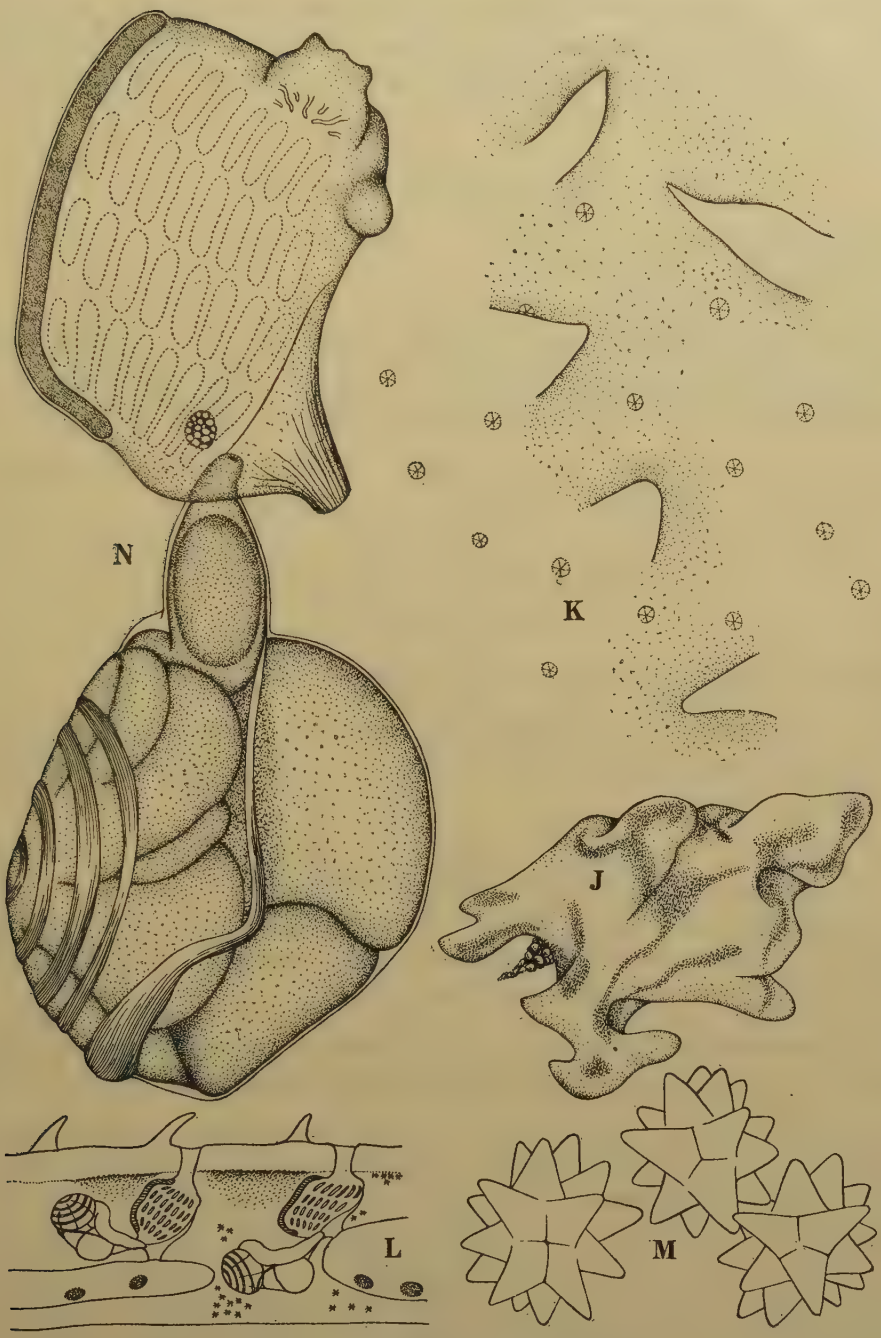


Fig. 2. *Leptoclinides echinatus* n. sp.
J—45 mm×30 mm colony. K—A part of the colony surface, ×25. L—Optical section of colony, enlarged. M—Spicules, ×630. N—Zooid from left side, ×75.

Remarks: The echinate appearance of the test surface and the large testis comprising much more follicles than in *Lept. ocellatus* (SLUITER) and *Lept. madara* TOKIOKA, both provided with large zooids, can be accepted as characteristics of the present new species.

7. *Distaplia dubia* (OKA), 1927

Leptobotrylloides dubium—OKA. A. 1927.
Distaplia japonica—TOKIOKA 1951.
Distaplia dubia—TOKIOKA 1953.

Colonies from Minami-hama of Nagasaki on May 20, 1951: Test dark grayish blue in colour and sprinkled with whitish zooids. Stomach yellowish in colour; testicular follicles up to 15 in number. Trunk of larva ca. 1.1 mm in length.

Colonies from Tannowa on June 10, 1952: Encrusting *Sargassum*. Longitudinal plications of the stomach rather obvious.

8. *Ciona intestinalis* (LINNAEUS), 1767

(Pl. VI, Fig. 10)

Ciona intestinalis—HARTMEYER 1906; OKA, A. 1927, 1935; TOKIOKA 1951, 1953.

Some individuals were attached to the oyster shells collected in Osaka Bay on April 5, 1951. Some of the supporting processes of the inner longitudinal vessels are of "*pulchella*"-type.

9. *Ascidia alpha* TOKIOKA, 1953

Ascidia alpha—TOKIOKA, T. (1953 a): Contributions to Japanese Ascidian Fauna V. Ascidians collected near the Marine Biological Laboratory of Hirosima University in the Inland Sea (1), Publ. Seto Mar. Biol. Lab., III (1), pp. 10–11, Fig. 6.

Two individuals in the second material: Bodies respectively 25 mm and 26 mm in length. Branchial aperture 8 and atrial aperture 6–7 lobed.

An individual in the 4th material: The body 28 mm in length and attached to the substratum by the whole left side. Test soft cartilaginous, considerably thick on the right side and pale grayish yellow in colour. The surface seems to be smooth originally and free from foreign matters, although some irregular grooves may occur on the surface in preservation. Mantle body 17 mm in length including the branchial siphon and flesh in colour. Both siphons relatively long; atrial siphon situated on the level of the anterior fourth of the body length excluding the siphon. The anterior margin of the intestinal loop does not reach the base of the atrial siphon, consequently anus opens slightly in front of the anterior end of the loop.

The axis of the second intestinal loop passes the pyloric end of the stomach which is elongate and with ca. 5 plications on the left side. Oesophagus opens to the branchial sac at the middle of the range from the base of the atrial siphon to the posterior end of the body. Inner longitudinal vessels ca. 40 and transverse vessels ca. 80 on each side. Gonad immature.

10. *Ascidia gamma* n. sp.

(Pl. VI, Figs. 12–15)

A 21 mm long individual in the second material. The body roughly oval in outline and attached to the substratum by the whole left side. Branchial aperture subterminal, atrial aperture situated near the branchial; both apertures sessile. Test soft cartilaginous and translucent. The surface is roughly smooth, although several irregular grooves are observable.

Mantle body: Branchial siphon terminal, atrial siphon situated slightly in front of the middle of the body; both siphons of moderate length and coloured yellowish near the aperture. Branchial aperture 8– and the atrial 7–lobed.

Branchial sac: Plications scarcely discernible. Thirty–two inner longitudinal and ca. 70 transverse vessels on each side. Three to four stigmata in a mesh. Tentacles ca. 50, ciliated groove C–shaped and opened anteriorly, and dorsal lamina with many ribs protruding beyond the margin of the lamina into small yellowish orange prominences. Supporting papillae of the inner longitudinal vessels are rather small.

Alimentary system: Intestinal loop strongly inclined dorsads, the anterior margin of the loop reaches the middle of the range between the bases of both siphons. The axis of the second intestinal loop passes the pyloric end of the stomach which is elongate and longitudinally plicated faintly. Gonad immature.

Remarks: It is not impossible that the present specimen represents merely a deformed individual of the preceding species or *As. ahodori* Oka. It is, therefore, desirable that the present name is accepted as a provisional one.

11. *Ascidia zara* Oka, 1935

(Pl. VI, Fig. 16)

Ascidia zara—Oka, A. 1935; Tokioka 1953, 1953 a.

Two individuals in the third material. They were found on the oyster shells collected on April 5, 1951 and both 25 mm in length. Test transparent. The anterior margin of the intestinal loop reaches beyond the base of the atrial siphon up to nearly 2/3 of the range between the bases of both siphons. Anus situated near

the middle of the visceral mass. Stomach with ca. 8 plications on each side. Ciliated groove U-shaped. Ovary purplish black in colour in an examined specimen.

12. *Ascidia sydneiensis divisa* (SLUITER), 1898

(Pl. VI, Fig. 17)

? *Ascidia pyriformis*—HERDMAN 1882.
Ascidia canaliculata—SLUITER 1885.
Ascidia divisa—SLUITER 1898, 1904; HARTMEYER 1906; TOKIOKA 1951.
Ascidia sydneiensis (in part)—HARTMEYER 1919; VAN NAME 1945.
Ascidia sydneiensis divisa—TOKIOKA 1953.

Six individuals (21 mm–55 mm in length) in the second, a 17 mm long individual in the third (from the oyster shell collected off Ozaki on Feb. 18, 1951) and 6 individuals (24 mm–65 mm in length) in the fourth material. In all individuals the ciliated groove describes a very complex configuration. Exceptionally in the 65 mm long individual, the anterior margin of the intestinal loop ends at the anterior base of the atrial siphon. (1) The existence of many protuberances on the test and the correspondent mantle prominences. (2) The rectum is slightly thickened at the bottom part of the second intestinal loop. These two features may be added to the characteristics of the present species. In the 17 mm long individual, the body is somewhat purplish near the apertures.

13. *Botryllus primigenus* OKA, 1928

Botryllus primigenus—OKA, A. 1928; VAN NAME 1945; TOKIOKA 1951, 1953.

A small colony referable to this species with some doubts was collected at Tannowa on June 10, 1952. It must be noticed that there are found some colonies representing some intermediate states of system-forming between the present species and next one.

14. *Botryllus communis* OKA, 1927

Botryllus communis—OKA, A. 1927, 1927 a; TOKIOKA 1951, 1951 a, 1953, 1953 a; CHIN 1934 (Lingnan Sci. Journ. Canton, Vol. 13, No. 3, p. 490).

A purplish black botryoid colony from the oyster shell collected on Feb. 18, 1951. It consists of small spherical masses, ca. 6 mm in diameter. Besides, small colonies on *Zostera* collected st Tannowa on June 10, 1952.

15. *Botrylloides violaceum* OKA, 1927

Botrylloides violaceum—OKA, A. 1927 a; TOKIOKA 1949, 1951, 1951a, 1953, 1953a, 1954.
? *Botrylloides carnosum*—OKA, A. 1927 a.
Botrylloides aurantium—OKA, A. 1927.

A damaged reddish brown colony encrusting a specimen of *Styela plicata* found in the fourth material. In the third material there are a considerable number of purplish-brown and flesh colonies collected at Minami-hama of Nagasaki on May 20, 1951 and a flesh colony collected at Satomati-ura of Okinosima near Tomogasima on May 6, 1951. Zooids in the former specimens are provided each with about ten orange~orange brown pigment flecks along each side of the endostyle.

16. *Symplegma reptans* (Oka), 1927

17. *Polyzoa pacifica* Tokioka, 1951

Both species were not included in the second-fourth materials.

18. *Cnemidocarpa areolata* (Heller), 1878

(Fig. 3)

Styela areolata—Herdman 1906, Van Name 1918, Tokioka 1950.
Tethyum areolata—Hartmeyer 1909.
Cnemidocarpa areolata—Tokioka 1953, 1953a, 1954.
Cnemidocarpa valborg—Hartmeyer 1919.

Five individuals (11–22 mm in length) in the second materials, a 12 mm long individual (collected on April 5, 1951) and 3 individuals (15 mm–38 mm in length, from Minami-hama of Nagasaki on May 20, 1951) in the third material and 2 individuals (11 and 14 mm long individuals attached to each other side by side) in the fourth material. Mantle yellowish orange~pale grayish purple or brown in colour. Both siphons and dorsal side are coloured reddish-brown or dark greenish. Small individuals in the fourth material are devoid of endocarps on the inner surface of the mantle excepting those in the first intestinal loop.

Branchial sac: Inner longitudinal vessels arranged as follows:

11 mm long individual:						
	Left	D. 5 (10)	4 (12)	4 (11)	4 (8)	3 V.
	Right	D. 4 (9)	4 (11)	4 (11)	4 (12)	4 V.
14 mm long individual:						
	Left	D. 4 (12)	3 (10)	4 (10)	4 (8)	3 V.
	Right	D. 3 (10)	4 (12)	4 (12)	3 (11)	4 V.
38 mm long individual:						
	Left	D. 10 (12)	4 (12)	4 (15)	4 (10)	4 V.
	Right	D. 6 (13)	4 (16)	4 (16)	4 (12)	4 V.

The 11 mm long individual has ca. 20 tentacles excluding minute ones (30–40 including minute ones). Ciliated groove deep U-shaped in all examined specimens. In

the 14 mm long individual thick transverse and parastigmatic vessels alternate regularly.

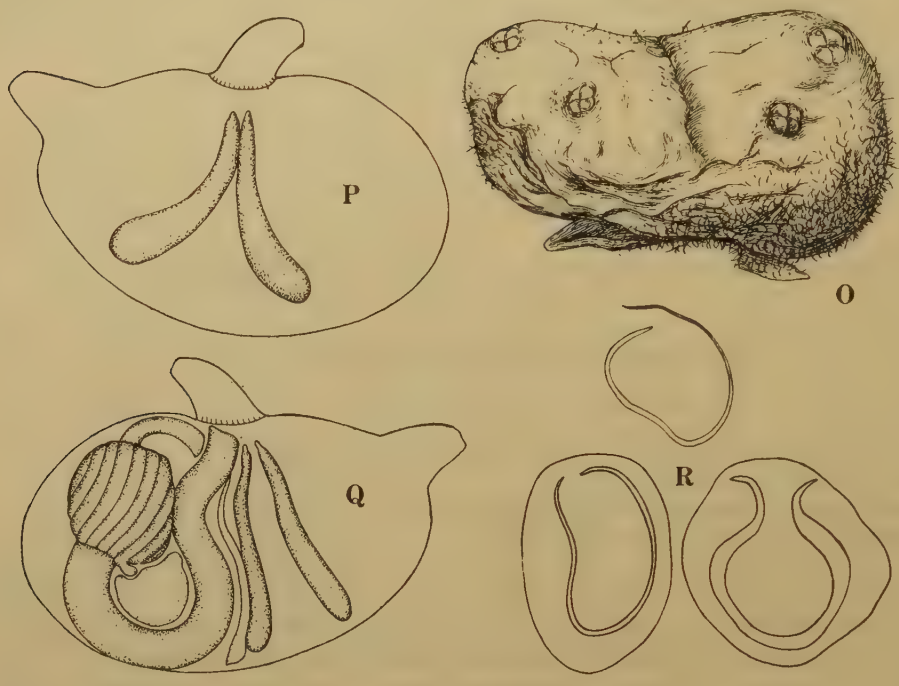


Fig. 3. *Cnemidocarpa areolata* (HELLER).
O—14 mm and 11 mm long individuals attached each other side by side. P—Right half of mantle body (14 mm long ind.), from inside. Q—Left half of mantle body (14 mm long ind.), from inside. R—Ciliated grooves, enlarged.

Alimentary system: Number of endocarps in the first intestinal loop is 3 (22 mm long individual)–5 (38 mm long individual) in examined specimens. The 14 mm long individual has merely a large endocarp in the loop besides a thin and long one along the anterior margin of the intestinal loop. Margin of anus plain (38 mm long individual) or slightly undulating. Plications on stomach ca. 20 in the 14 mm long individual. Minute but distinct pyloric coecum in the 14 mm long individual.

Gonad: 11, 14 mm long individuals:
Left 2 Right 2
22 mm long individual:
Left 2 Right 3
38 mm long individual:
Left 1 Right 2

19. *Cnemidocarpa fertilis* forma *minor* nov.

(Fig. 4; Pl. VII, Fig. 18)

A small ovoid individual attached by the ventral side to the surface of a *Pyura michaelseni* found in the fourth material. It is 10 mm long, 7.5 mm wide and 5.5 mm in height. Branchial aperture subterminal, atrial aperture near the middle of the dorsal side; both apertures 4-lobed and sessile. Test leathery, tough, somewhat reddish in colour on the dorsal side and very thin on the ventral side. The surface is irregularly wrinkled and holds some sand grains and other foreign matters along the periphery. Mantle pale flesh in colour. Small endocarps are scattered sparsely on the inner surface of the mantle. Atrial tentacles extremely delicate but long, ca. 40 in number.

Branchial sac: Inner longitudinal vessels are arranged as follows:

Left	D.	0 (12)	2 (8)	1 (10)	2 (6)	1 V.
Right	D.	0 (12)	1 (10)	1 (11)	1 (5)	? V.

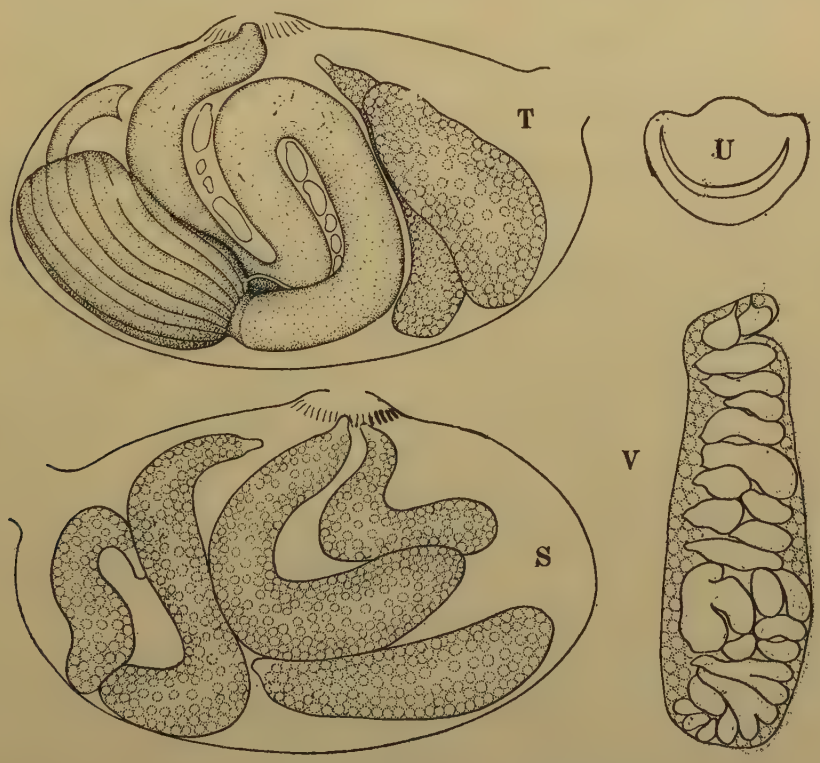


Fig. 4. *Cnemidocarpa fertilis* f. *minor* nov.
S—Right half of mantle body, inside. T—Left half of mantle body, inside. U —Ciliated groove, enlarged. V—Attachment surface of a 4 mm long gonad.

Thick and thin transverse vessels alternate regularly, parastigmatic vessels present. Four to six stigmata in a mesh. Tentacles ca. 30 including large and small ones, but excluding minute ones; they are yellowish white in colour. Ciliated groove crescent-shaped.

Alimentary system: Anterior end of the first intestinal loop beyond the middle of the body, 2 large and 4 small endocarps in the loop. The second intestinal loop is very deep and contains 2 large and 2 small endocarps; the axis passes through behind the pyloric end of the stomach which is elongate, less than a half of the ventral branch of the first intestinal loop and with ca. 12 plications on each side. Pyloric coecum absent.

Gonad: Two on the left and 5 on the right side. Large ones reach as long as 10 mm. Testicular follicles situated roughly transversely on the attachment surface.

Remarks: The present specimen is safely considered as a minor form of *Cn. fertilis*, which attained to the maturity at such a small size. The characteristic arrangement of the alimentary canal seems to guarantee the present idea.

20. *Cnemidocarpa macrogastra* (OKA), 1935

Styela macrogastra—OKA. A. 1935.
Cnemidocarpa macrogastra—TOKIOKA 1953, 1953a, 1953b.

A 20 mm long grayish white individual in the second material. The third material contains 7 individuals, namely 3 individuals (up to 9 mm in length, found on the oyster shell collected on April 5, 1951), 2 individuals (up to 18 mm long, from Minami-hama of Nagasaki on May 20, 1951) and 2 individuals (20-27 mm in length, found on the oyster shell collected on March 9, 1951). The 18 mm long individual attached to the substratum by the right posterior side of the body; test is slightly reddish around the apertures and the mantle is orange yellow in colour fading towards the ventral side. The 20 mm long individual in the third material is attached to the substratum by the left side of the body. The neighbourhood of apertures somewhat greenish. The 27 mm long individual is very peculiar in the appearance. Test is grayish, wrinkled very irregularly on the surface; the posterior half of the body is covered with a thin muddy coat. Mantle yellowish in colour, reddish orange around the apertures. Stomach much longer than at least a half of the ventral branch of the first intestinal loop.

21. *Styela partita* (STIMPSON), 1852

(Pl. VII, Figs. 19-20)

Cynthia partita—STIMPSON 1852.
Styela variabilis—ALDER & HANCOCK 1907.

Styela partita var. *bermudensis*—Van Name 1902.
Styela partita bermudensis—Van Name 1921.
Tethyum partitum—Van Name 1912, Salfi 1931.
Styela partita—Van Name 1921, 1924, 1945 (Bull. American Mus. Nat. Hist., Vol. 84, pp. 290–293, Pl. 3 figs. 7–8, Pl. 10 fig. 3, Figs. 179 E, 180 C, 188); Harant 1930; Berrill 1932; Oka, A. 1934; Pérès 1949, 1951; Tokioka 1951, 1953, 1953a, 1954; Millar 1953 (Proc. Zool. Soc. London, Vol. 123, Pt. II, pp. 311–312).

Common in the bay. Twenty-three individuals (4 mm–18 mm in length) in the second material, 3 individuals, up to 7 mm in length and being attached to the specimen of *Styela plicata* found in the fourth material, and 14 individals in the third material. The sources of the last specimens are:

No. 1 Two 17 mm long individuals from Satomati-ura of Okinosima near Tomogasima on May 6, 1951.
No. 2 A 15 mm long individual from the oyster shell caught off Ozaki on Febr. 18, 1951.
No. 3 Five individuals (up to 26 mm in length) from the oyster shells collected on April 5, 1951.
No. 4 A 12 mm long individual from Minami-hama of Nagasaki on May 20, 1951.
No. 5 Three individuals (14–18 mm in length).
No. 6 A 22 mm long individual attached to the barnacle caught in a net at the northern side of Okinosima on June 10, 1951.
No. 7 A 12 mm long somewhat elongate individual from the estuary of the river Onosato on April 24, 1951.

The preserved specimens are usually yellowish white~grayish yellow with reddish brown tint around the apertures. The 15 mm long individual (No. 2) is oval in outline and quite smoothly surfaced. It has 2 immature gonads on each side; the inner longitudinal vessels arranged on the left side as D. 4 (15) 4 (14) 4 (14) 5 (9) 3V. The 26 mm long individual (in No. 3) has 2 gonads on the right, but one on the left, missing the anterior one. The 22 mm long individual (No. 6) has 3 gonads on the right side.

22. *Styela plicata* (Lesueur), 1823

(Pl. VII, Fig. 21)

Styela plicata—Traustedt 1885; Traustedt & Weltner 1894; Herdman 1899; Hartmeyer 1905, 1906; Redikorzev 1916; Van Name 1921, 1945; Oka, A. 1927, 1935; Harant 1930; Pérès 1949, 1951; Tokioka 1951a, 1953; Kott 1952.
Tethyum plicatum—Van Name 1912, 1931.

Nineteen individuals (8 mm–40 mm in length) in the second material, 4 individuals (up to 17 mm, from the oyster shells collected on April 5, 1951) in the third and 5 individuals (30 mm–50 mm in length) in the fourth material. The specimens in the third material resemble superficially *St. partita*. They are oval in outline, attached to the substratum by the posterior end; test cartilaginous, milky white as a whole and coloured reddish brown solely around the 4-lobed apertures. The sur-

face is nearly smooth, except a few faint wrinkles. Mantle pale flesh in colour. In all individuals of this material the gonad was not yet formed. The number of gonads in specimens in the fourth material is as follows:

30 mm long individual	Left	2	Right	7
35 mm „		3		7
35 mm „		2		7
35 mm „		3		7
50 mm „		3		8

It is a noteworthy fact that there are a considerable number of individuals which have 3 gonads on the left side.

22a. *Styela plicata* f. *tenuis* TOKIOKA, 1951

Styela plicata f. *tenuis* TOKIOKA 1951a.

Five individuals (20–39 mm in length) in the second material. I have observed a few individuals of this form collected near the estuary of Edogawa in the inner part of Tokyo Bay.

23. *Styela isibasii* TOKIOKA, 1951

Not represented in the second~fourth materials.

24. *Styela clava* HERDMAN, 1881

Styela clava HERDMAN 1881, 1882; DRASCHE 1884; TRAUSTEDT 1885; HARTMEYER 1906; OKA, A. 1927, 1935; TOKIOKA 1951, 1951a, 1953, 1953a.
Botryorchis clava REDIKORZEV 1916.

Three individuals (a 12 mm long individual and two individuals, both 22 mm in body length and with 18 mm long stalk, attached to the oyster shells from Ozaki on Febr. 18, 1951) in the third material and a 21 mm long individual in the fourth material.

25. *Pyura michaelseni* (OKA), 1906

(Pl. VII, Figs. 22–25)

Halocynthia michaelseni—OKA, A. (1906): Notizen über japanische Ascidien I, Annot. Zool. Japon., Vol. VI, Part 1, pp. 46–47.
Cynthia michaelseni—OKA, A. 1927, 1935.
Pyura michaelseni—TOKIOKA 1949.

Nine individuals (22 mm–63 mm in length) in the second material, 31 individuals (less than 14 mm in length, being crowed on the oyster shells collected at Ozaki on Febr. 18 and April 5, 1951) in the third material and 10 individuals (7–45 mm in

length) in the fourth material. The test is cartilaginous (exceptionally it may be leathery) and usually purplish or slightly reddish purple in colour, but fades to white in preservation. In small individuals, the test is somewhat translucent and pale reddish-purple~milky white with a faint gray-purplish tint. The surfaces of smaller individuals are usually smooth, excepting a few small prominences; while the surface is completely wrinkled and carries many foreign matters in the ventral half in larger individuals, although wrinkles, grooves and adhering foreign matters decrease remarkably on the dorsal area. The animals are attached to the substratum by the ventral side and rarely two individuals are found being fused with each other side by side. The test may reach 3.5 mm in thickness in some thickened parts, but it is less than 1 mm at some thin places. Both apertures are sessile and marked each with 8 (4 in young individuals) lobules. The dorsal ridge uniting both apertures in *P. sanderi* is quite obscure in the present species. The mantle body is reddish or pale brownish purple in the dorsal side, but paler in the ventral side; siphons deep red, both apertures 4-lobed.

Branchial sac: The arrangement of the inner longitudinal vessels in smaller individuals is as follows:

5 mm long roughly spherical individual:

Left	D.	0 (5)	0 (6)	0 (10)	1 (8)	1 (7)	0 (3)	0 V.
Right	D.	0 (8)	0 (5)	1 (9)	0 (6)	1 (6)	1 (3)	0 V.

11 mm long individual:

Left	D.	1 (12)	1 (11)	1 (13)	1 (11)	1 (11)	1 (6)	0 V.
Right	D.	0 (13)	1 (11)	1 (12)	1 (13)	1 (11)	1 (10)	2 V.

In the former, about 3 stigmata are counted in a mesh, parastigmatic vessels present, and ciliated groove simply U-shaped.

Alimentary system: Liver is divided into a few masses which are not aggregated compactly and yellowish brown in colour.

Gonad: Immature gonad is observed already in a 11 mm long individual. In a 36 mm long individual, the left gonad consists of 14 and the right one of 15 genital capsules.

Remarks: This ascidian is most frequently pierced with the bivalve, *Musculus* sp., a small shell of which was ever found in a 5 mm long individual.

26. *Pyura lepidoderma* Tokioka, 1949

(Fig. 5)

Tokioka, T. (1949): Contributions to the Japanese Ascidian Fauna I. Ascidians collected by Prof. Miyadi and Mr. Masui during the bottom survey 1939-40, Publ. Seto Mar. Biol. Lab., Vol. I, No. 1, p. 10, Pl. 5 figs. 1-3.

TOKIOKA 1953a, 1953b.

Five individuals (8 mm–15 mm in length) in the second material, 2 individuals (both 15 mm in length, being attached to the shell fragment from Ozaki on Dec. 18, 1951) in the fourth material and 5 individuals (12 mm–19 mm in length) in the third material. Most of the specimens in these materials are somewhat erect oval in outline and attached to the substratum by the posterior end of the body. Test usually whitish in colour. The mantle body is yellowish orange~reddish orange in colour when alive, especially coloured deeply on the dorsal side and on the siphons.

Branchial sac: Inner longitudinal vessels arranged as follows:

12 mm long individual (on the oyster shell from Ozaki on Febr. 18, 1951):

Left D. 1 (12) 1 (9) 1 (14) 2 (12) 1 (8) 2 (6) 3 V.

Right D. 1 (9) 2 (6) 2 (12) 2 (12) 2 (9) 2 (4) 3 V.

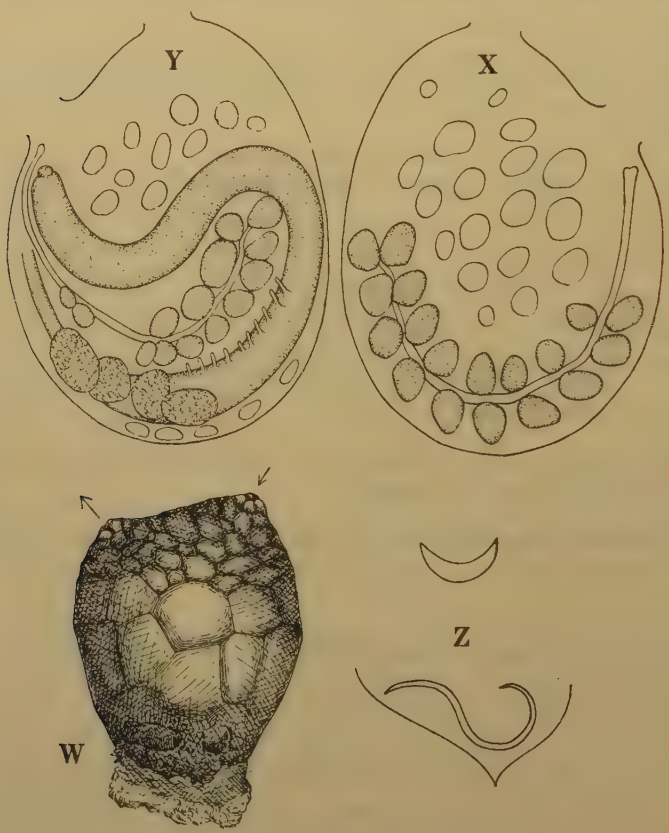


Fig. 5. *Pyura lepidoderma* TOKIOKA.
W—12 mm long oval individual. X—Right half of mantle body (12 mm long ind.), inside. Y—Left half of mantle body (12 mm long ind.), inside. Z—Ciliated grooves, enlarged.

19 mm long individual (from Minami-ura of Nagasaki on May 20, 1951):

Left D. 0 (15) 1 (10) 2 (13) 2 (13) 2 (10) 2 (6) 1 V.
Right D. 0 (12) 2 (9) 2 (13) 2 (14) 2 (11) 2 (9) 2 V.

Three-five stigmata in a mesh in the 12 mm long individual, while 5–9 ones in the 19 mm long individual. Tentacles ca. 30 in the 19 mm long individual, including ca. 15 large tentacles and small ones of about the same number.

Alimentary system: Liver yellowish brown in colour and usually divided into anterior and posterior groups being combined with each other by a narrow piece of the same organ.

Remarks: A 12 mm long individual was found being quite deformed by the penetration of two shells of *Musculus* sp.

27. *Pyura mirabilis* (v. Drasche), 1884

(Pl. VII, Fig. 26; Pl. VIII, Figs. 27–33)

Cynthia mirabilis—v. Drasche, R. F. (1884): Ueber einige neue und weniger gekannte aussereuropäische einfache Ascidien, Denkschriften der mathem.-naturw. Cl., Bd. XLVIII, pp. 377–378, Pl. VI Figs. 2–7.
Halocynthia mirabilis—Oka, A. 1906.
Cynthia mirabilis—Oka. A. 1927.
Pyura mirabilis—Van Name 1945.

Two individuals in the fourth material. They were collected on Dec. 18, 1951 and respectively 27 mm and 40 mm in length. The animal attached to the substratum by the underside; the branchial terminal of the oblong body is narrower than the atrial terminal. Test cartilaginous~leathery, about 1 mm in thickness, and yellowish white in colour; only the branchial aperture is coloured orange. The surface of the perfectly preserved specimen is nearly smooth excepting a few faint transverse wrinkles and quite free from foreign matters.

Mantle body: About 25 conspicuous transverse muscles are arranged regularly on the dorsal side and ca. 10 thinner longitudinal muscles running beneath the former. The anterior half of the ventral side is occupied by ca. 10 thin longitudinal muscles, thin transverse muscles are confined along the periphery and lying beneath the longitudinal ones. Endocarps absent. Spinules on the distal part of the stomodaeum are ca. 65μ in length, tips are bluntly pointed.

Branchial sac: Seven folds on each side. Inner longitudinal vessels are arranged as follows in the 40 mm long individual:

Left D. 2 (13) 3 (10) 2 (9) 3 (11) 3 (12) 3 (11) 1 (8) 0 V.
Right D. 2 (14) 2 (9) 3 (8) 3 (11) 3 (12) 3 (12) 2 (7) 0 V.

The arrangement of the transverse vessels is somewhat irregular, usually ca. 5 medium～thinner vessels between each pair of thicker ones. Parastigmatic vessels present. Five to eight stigmata in a mesh. Tentacle ca. 20, including large and small ones; the larger ones are 13–15 in number; branches in 2 orders. Ciliated groove C-shaped opened anteriorly and with one or both arms incurled. Dorsal languets slender and long.

Alimentary system: Alimentary canal describes a simple and narrow U-shaped loop opened towards the atrial aperture. Gastric portion occupies a considerably wide range of the ventral branch of the intestinal loop. The anterior margin of the loop reaches the middle of the body in fully expanded specimens and to 2/3–3/4 of the body length or more in contracted specimens. Liver forms a compact mass and greenish brown in colour. Margin of the anus undulating, but not divided into lobules.

Gonad: One on each side. Ovary is an elongate sac, slightly undulating on the right side and yellowish-brown in colour. Testicular follicles are arranged along each side of the gonad and pinkish in colour; they are complexly lobated.

Remarks: The appearance of the gonad resembles closely that of *Herdmania momus*. These saccular gonads differ distinctly from those found in many common species of the genus and consisting of a number of genital capsules. Is it an unreasonable idea to treat the species having saccular gonads, *Herdmania momus*, *Pyura mirabilis* and some species of *Pyura*, under a group separate from most of the species of *Pyura* having gonads consisting of genital capsules?

28. *Boltenia isibasii* n. sp.

(Fig. 6)

One specimen in the second material. The body is oblong, 30 mm long × 17 mm wide and 20 mm in height, being attached to the substratum by the ventral side. Both apertures situated subterminally at each end; siphons extremely short. Test leathery, very hard and reddish-orange in colour. The dorsal side is provided with many tubercular prominences, of which larger ones are aggregated in areas surrounding the apertures and smaller ones are distributed sparsely in other parts of the body. Many irregular grooves are found on the ventral side. Test ca. 1.8 mm in thickness and whitish on the innerside.

Mantle body: Mantle of moderate thickness and yellowish as a whole, being slightly coloured reddish orange near the apertures. Both transverse and longitudinal muscles are well developed, the latter lying beneath the former. Atrial velum very remarkable.

Branchial sac: Seven folds on each side. Inner longitudinal vessels arranged as follows:

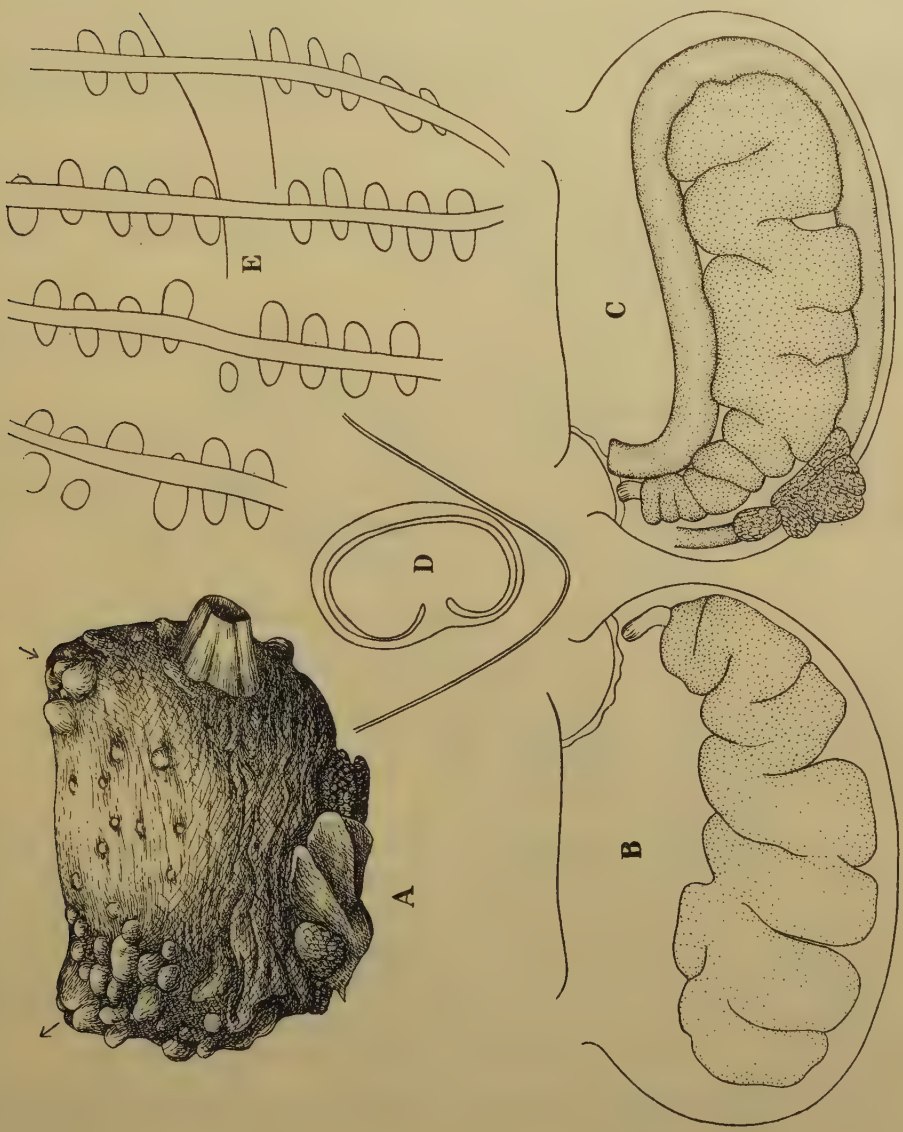


Fig. 6. *Boltenia isibasii* n. sp.
A—30 mm long individual, right side. B—Right half of mantle body, inside. C—Left half of mantle body, inside. D—Ciliated groove, enlarged. E—A part of branchal sac, inside, ×75.

Left D. 1 (27) 3 (18) 2 (24) 3 (24) 3 (22) 3 (15) 3 (12) 1 V.
Right D. 1 (21) 4 (12) 4 (21) 5 (28) 4 (21) 4 (18) 3 (12) 2 V.

A row of short stigmata under each longitudinal vessel. Nine large and the same number of small tentacles alternate regularly, besides a minute one at each interval; branches in 2 orders. Ciliated groove C-shaped, opened to the left as we face it. Dorsal languets distinct.

Alimentary system: The alimentary canal forms a wide U-shaped loop and with very shallow second intestinal loop. Gastric area small, liver whitish in colour and somewhat translucent. Anus plainly margined.

Gonad: Large one gonad on each side. It is lobated as shown in figures and yellowish in colour.

Remarks: The appearance of body which is wholly devoid of spines on the surface, resembles closely *Halocynthia transversaria* Sluiter (1904) from the Siboga Area. The latter differs, however, from the former in number of the branchial folds which are 6 (5 wide and 1 very narrow ones in 3 cm long individual) in the latter.

29. *Halocynthia roretzi* (v. Drasche), 1884

(cit. Text-fig. 20 in Ascidians of Sagami Bay)

Cynthia Roretzii—Drasche 1884, Traustedt 1885.
Halocynthia roretzi—Hartmeyer 1906; Oka, A. 1906; Tokioka 1951, 1953.
Cynthia roretzi f. *typica* + var. *ivamiana* + var. *sikokiana*—Oka, A. 1926.
Cynthia roretzi—Oka, A. 1927, 1935.

Two individuals in the third material. They are respectively 28 mm and 27 mm in length, and attached to the oyster shells collected at Ozaki on Febr. 2, 1951. The body is nearly spherical, coloured orange in the anterior half and grayish in the posterior half and provided with many small spines around the apertures. Some of the spines have the thick basal portion. Thirteen folds on each side of the branchial sac, of which the 11th is confined in the posterior half of the sac, 12th in the posterior third and the 13th in the posterior fourth. Gonad not yet formed.

Remarks: Mr. R. Isibasi told me that a considerable number of large individuals of the present species are fished by some inhabitants as food near Tannowa.

30. *Eugyrioides glutinans* (Moeller), 1842

(Fig. 7)

Eugyra glutinans Traustedt (in part) 1880, Kiaer (in part) 1896, Hartmever (in part) 1903, Van Name 1945.

Paramolgula arctica—Bonnevie 1896.
Paramolgula rara—Kiaer 1896.
Eugyrioides schmidti—Hartmeyer 1911, 1912; Redikorzev 1916.
Eugyrioides glutinans—Redikorzev 1916; Tokioka 1953, 1953a.
Eugyrioides arctica—Redikorzev 1916.
Eugyrioides asamusi—Oka, A. 1930, 1935; Tokioka 1949.

Two 20 mm long individuals in the fourth material and 6 individuals (13 mm –30 mm in length) in the third material. Most of the present specimens are all very large. The 30 mm long individual dredged by a fishing boat off Ozaki on

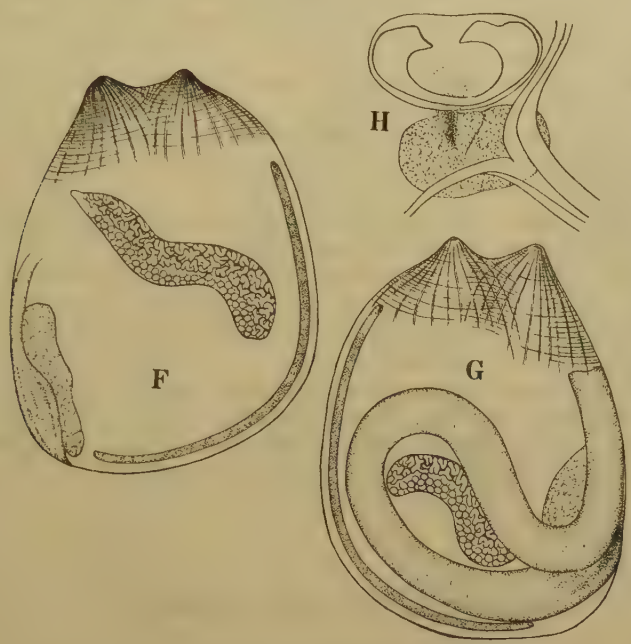


Fig. 7. *Eugyrioides glutinans* (Moeller).
F—Mantle body from right side (18 mm long ind.). G—Mantle body from left side (18 mm long ind.). H—Ciliated groove, subneural gland and anterior parts of wide and narrow dorsal laminae, enlarged.

Febr. 12, 1951 seems to be the maximum record in this species. The body is oval ~spherical in outline, covered wholly with mud except for the siphonal area which is pinkish in colour. About 20 short longitudinal muscles on the siphonal area of the body. The VIII (ventral-most) longitudinal row of infundibula consists of 10 (1. 2. 2. 2. 2. 1) infundibula on the left and 11 (1. 2. 2. 2. 2. 2) ones on the right side in an examined 18 mm long specimen. Free margin of anus plain, testis pinkish in colour.

ADDENDUM: *Pegea confoederata* (FORSKÅL), 1775

Two stranded aggregated forms are found in the fourth material. They are both 32 mm in length. There are a pair of short crests on the ventral side just in the position where the crest-like organs are situated in the aggregated form of *P. c. bicaudata*, although they are too faint to be detected easily.

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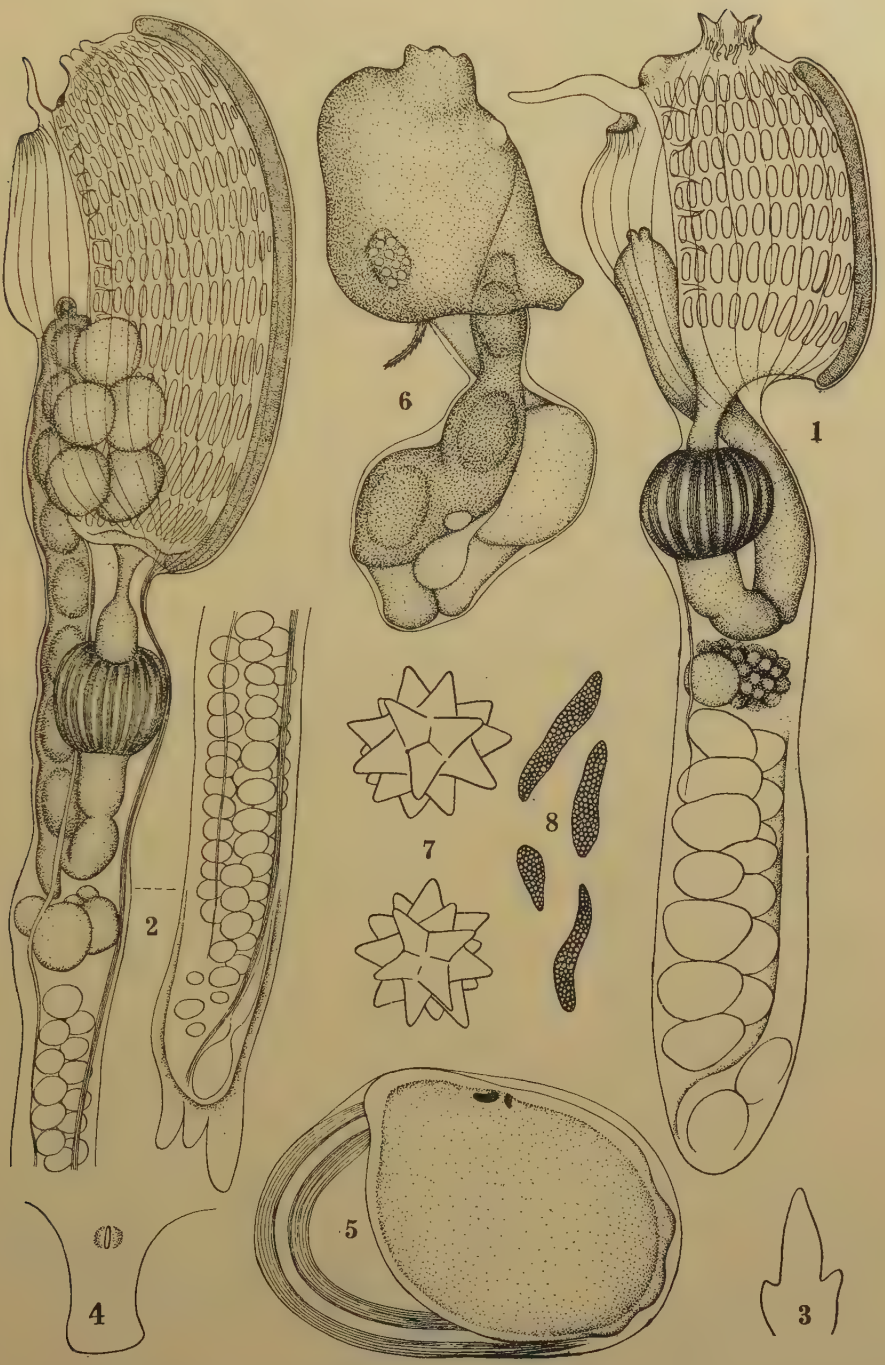
EXPLANATION OF PLATE V

Fig. 1. *Amaroucium multiplicatum* (SLUITER), zooid from right side, enlarged.

Figs. 2–5. *Amaroucium pliciferum* REDIKORZEV.
2–Zooid from right side, enlarged.
3–Atrial languet, magnified.
4–Ciliated groove, magnified.
5–Larva, not yet fully developed, ×75.

Figs. 6–8. *Leptoclinides nigrothorax* n. sp.
6–Zooid from left side, ×75.
7–Spicules, ×440.
8–Granulate cells, ×440.



T. TOKIOKA: CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA, X.

EXPLANATION OF PLATE VI

Fig. 9. *Didemnum* sp., zooid from right side, ×75.

Fig. 10. *Ciona intestinalis* (L.), two supporting papillae of inner longitudinal vessels, ×75.

Fig. 11. *Ascidia alpha* TOKIOKA, left side of mantle body, 28 mm long individual.

Figs. 12–15. *Ascidia gamma* n. sp.
12–21 mm long individual, right side.
13–Right side of mantle body.
14–Left side of mantle body.
15–Ciliated groove, enlarged.

Fig. 16. *Ascidia zara* OKA, ciliated groove, enlarged.

Fig. 17. *Ascidia sydneiensis divisa* (SLUITER), ×2.7

T. Tokioka: Contributions to Japanese Ascidian Fauna, X.

EXPLANATION OF PLATE VII

Fig. 18. *Cnemidocarpa fertilis* f. *minor*, nov. 10 mm long individual.

Figs. 19–20. *Styela partita* (STIMPSON).

19–15 mm long oval individual.

20–7 mm long individual.

Fig. 21. *Styela plicata* (LESUEUR), 15 mm long individual.

Figs. 22–25. *Pyura michaelseni* (OKA).

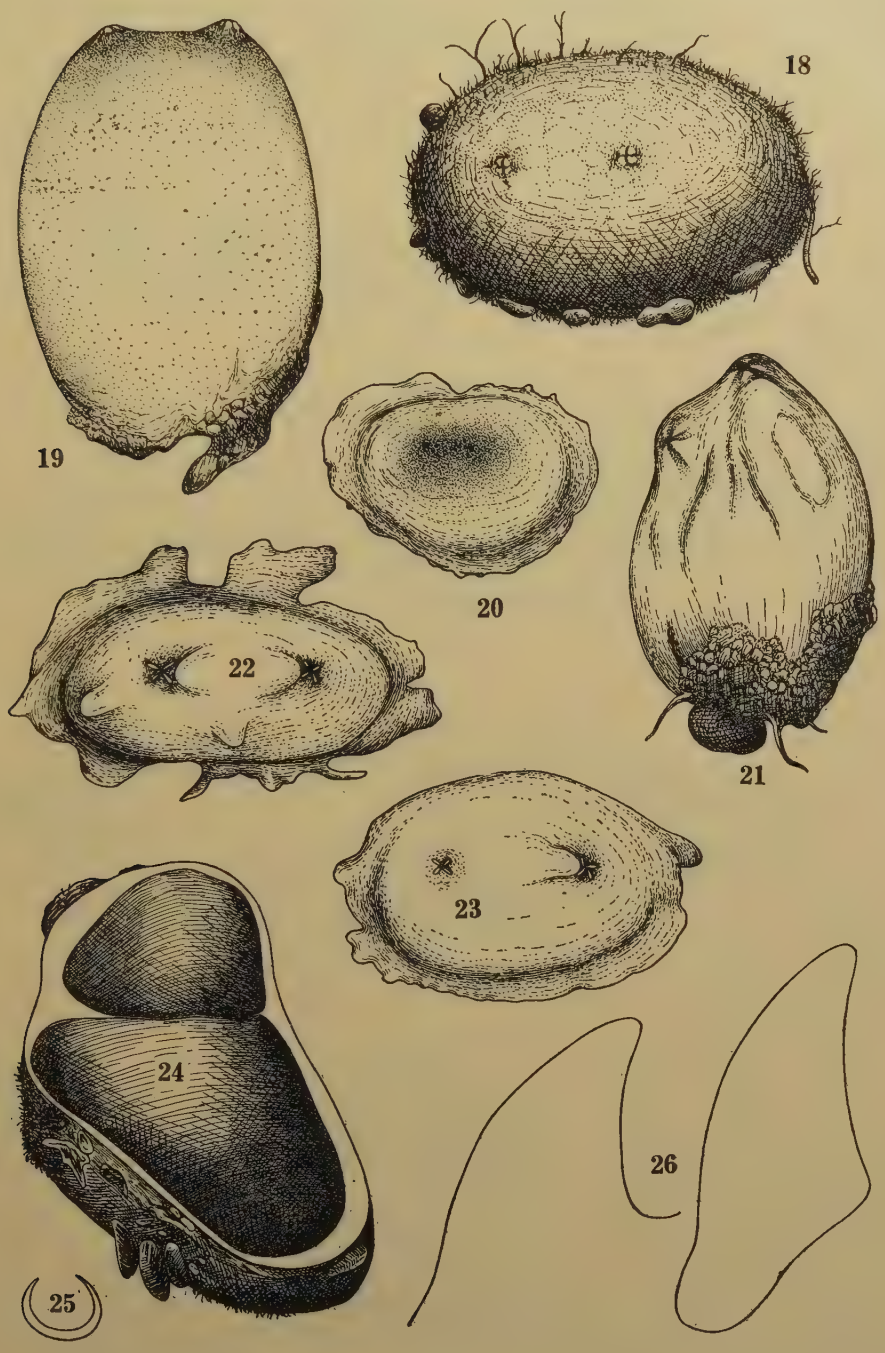
22–10 mm long individual.

23–7 mm long individual.

24–Section of empty test containing respectively 25 mm and 36 mm long mantle bodies which are attached each other side by side, with a thin test wall between them.

25–Ciliated groove of a 5 mm long individual, enlarged.

Fig. 26. *Pyura mirabilis* (v. DRASCHE), spinules from the distal part of stomodaeum, ×1200.



T. Tokioka: Contributions to Japanese Ascidian Fauna, X.

EXPLANATION OF PLATE VIII

Pyura mirabilis (V. DRASCHE).

Fig. 27. 40 mm long individual, right side.

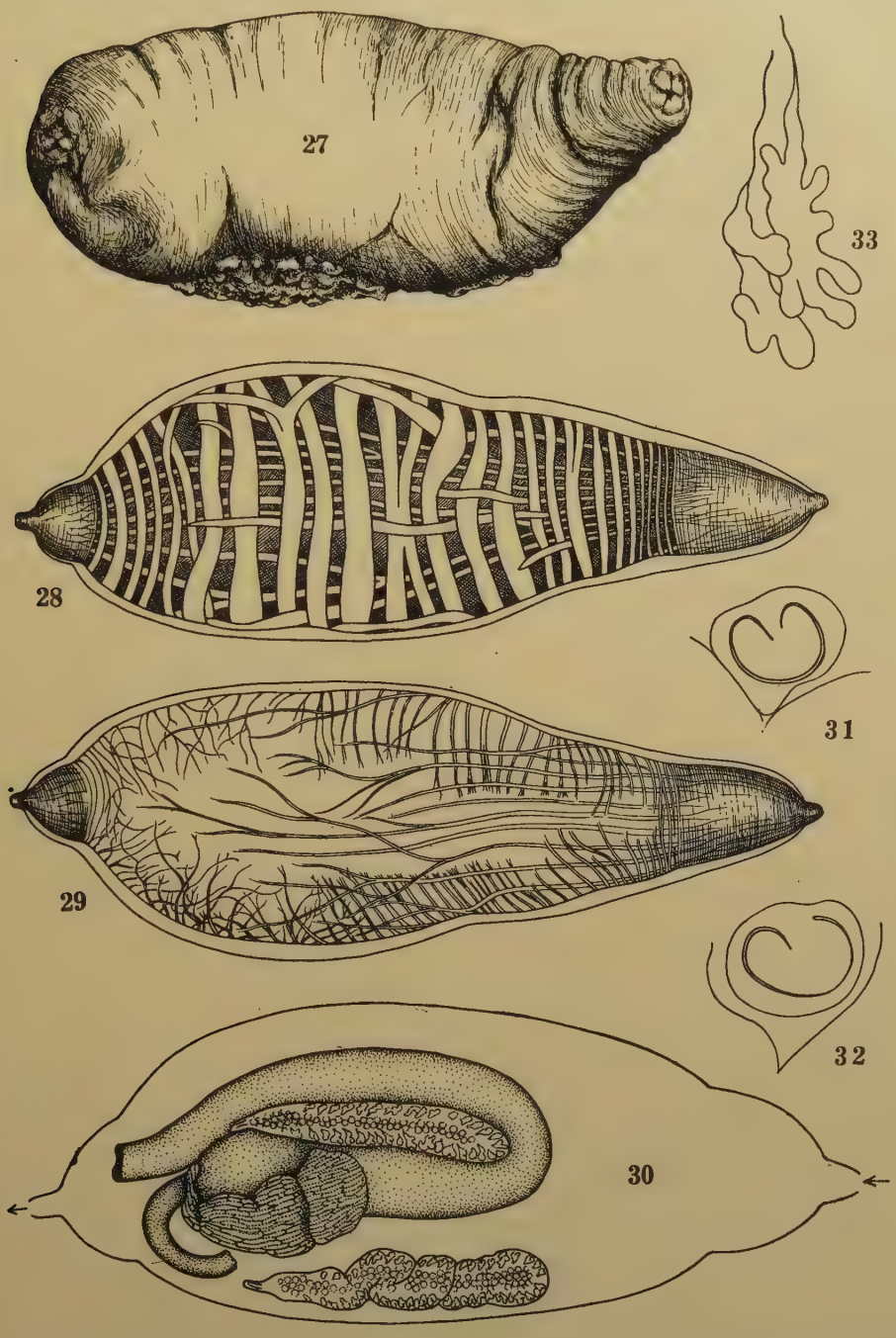
Fig. 28. Dorsal side of mantle body.

Fig. 29. Ventral side of mantle body.

Fig. 30. Ventral half of mantle body, from inside.

Fig. 31. 2 testicular follicles, magnified.

Fig. 32, 33. Ciliated grooves, enlarged.



T. Tokioka: Contributions to Japanese Ascidian Fauna, X.

DROPLETS FROM THE PLANKTON NET[1)]

TAKASI TOKIOKA
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XIV. On a Small Collection of Chaetognaths from the Central Pacific. (Fig. 18)

A small collection of chaetognaths, hauled by KITAHARA's quantitative plankton net or young fish tow-net from 100 m to surface near the Phoenix and Gilbert Islands during the period from February to March 1953, was submitted to me for examination by the courtesy of Prof. T. CHIBA and Mr. S. TSURUTA of the Simonoseki College of Fisheries, to whom I wish to express here my hearty thanks for their kindness. This material comprises the following nine forms:

Species	Individual number	Percentage
1. *Sagitta hexaptera*	8	3.3
2. *Sagitta enflata*	112	46.9
3. *Sagitta bipunctata*	29	12.1
4. *Sagitta robusta*	15	6.3
5. *Sagitta ferox*	12	5
6. *Sagitta serratodentata pacifica*	52	21.8
7. *Sagitta regularis*	1	0.4
8. *Pterosagitta draco*	9	3.8
9. *Sagitta* sp.	1	0.4
	239	

Sagitta sp. (No. 9) is a problematical young form which is 3.9 mm in length. Tail segment occupies 34.9 % of the body length including the caudal fin. Body robust and opaque, being almost of uniform width. Lateral field rather narrow, muscles strong. Head of moderate size, neck distinct. Collarette practically absent, being found very faintly merely around the neck. No constriction at tail septum.

Anterior fin begins at the posterior end of the ventral ganglion. Posterior fin one and half as long as the anterior fin and lies more on the tail segment than on the trunk and broadest behind the septum. Distance between both fins very short. Rayless zone absent on either fin. The apparent shape of eye pigment very small and roundish. Corona ciliata of Type C, beginning behind the eyes and stretching

1) Contributions from the Seto Marine Biological Laboratory, No. 242.

on the trunk nearly one and a half as long as the head. It has a conspicuous depression on each side. Intestinal diverticula distinct. Hooks 10–10; anterior teeth 4–4; posterior teeth 5–5. Wing of the vestibular ridge reaches the first tooth, notch as deep as to reach the third tooth. Both ovaries and testes quite immature. Epiderm thickened slightly just behind the posterior fin.

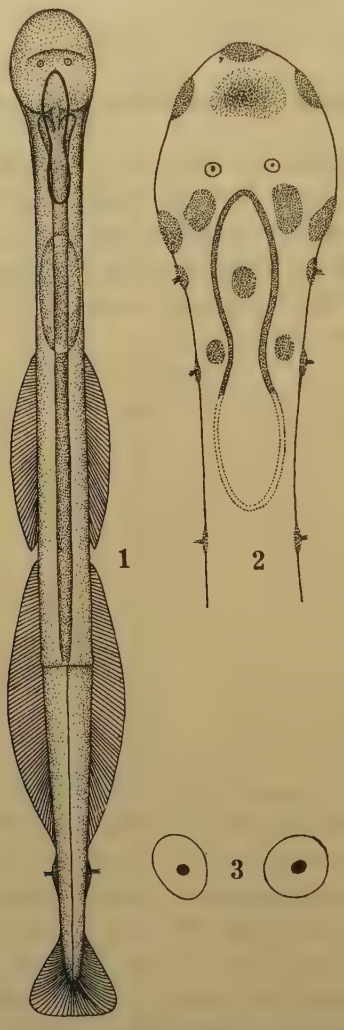

Fig. 18. *Sagitta* sp.
1...Entire animal, dorsal. ×33
2...Anterior part of the body, dorsal. ×75
3...Eyes. ×200

Remarks: *Sag. bedfordii* DONCASTER resembles the present form at a glance. The former shows the formula 9–12 $\frac{2\text{-}3}{2\text{-}3}$ at the body length near 4 mm (tail segment 36%) which is the maximum for this species. The latter has more teeth along both rows, slightly longer anterior fin and corona ciliata and quite immature sexually at 3.9 mm body length.

Sag. parva OYE is a small species and superficially very like the present form.

Even large individuals are less than 3.25 mm in length, tail segment 30% and armature formula is 6–8 $\frac{3–5}{6–7}$. The present specimen has more hooks and quite immature sexually at even 3.9 mm.

Young *Sag. regularis* seems to resemble the present specimen in the armament formula, but the former differs distinctly from the latter in the appearance of the collarette and the apparent shape of the eye pigment which is somewhat elongate in the former. Young *Sag. neglecta* and *Sag. oceanica* GRAY (=*Sag. lacunae* TOKIOKA) resemble the present specimen in the appearance of the collarette and in the outline of the eye pigment, but differ in the teeth formula. Young *Sag. ferox* and *Sag. robusta* (*Sag. ai* in TOKIOKA 1942, p. 541) conform well with the present specimen, excepting in number of hooks and the shape of the corona ciliata and the eye pigment. Ten hooks are not yet recorded for these two species, eye pigment of the preset specimen seems too small for the two species. Corona ciliata of Type C is possible to occur on very young individuals of the species which are provided with the corona of Type B in grown state (TOKIOKA 1942, p. 540).

These comparisons seem to induce me to the conclusion that the present specimen may belong to a new form or rather represent a young individual of *Sag. ferox* or *Sag. robusta.*

Sag. enflata is the most dominant species in this collection, next *Sag. serratodentata pacifica* and followed by *Sag. bipunctata* and *Sag. robusta.* In a collection from the water surrounding the Palao Islands, *Sag. enflata* was the commonest species, next *Sag. serratodentata pacifica* and *Sag. ferox* and followed by *Sag. regularis, Sag. neglecta* and *Pt. draco*; in a small material from the Arafura Sea, *Sag. enflata* and *Sag. bedoti* f. *minor* were common and followed by *Sag. robusta* and *Ktta. pacifica* (TOKIOKA 1942).

It may be said safely that *Sag. enflata* is the commonest species and followed by *Sag. serratodentata pacifica, Sag. ferox* and *Sag. robusta* in the open sea water in the central Pacific. *Sag. neglecta, Sag. regularis* and *Sag. bipunctata* occur commonly, but not so abundant as the species mentioned above. *Pt. draco* and *Ktta. pacifica* are met with frequently, although they are rather few in number. *Sag. bedoti* occurred abundantly in the material from the Arafura Sea, but it is quite rare in other materials.

In the lagoon waters of the central Pacific, *Sag. enflata* and *Sag. oceanica* seem to be the commonest species. In lagoons of the Palao Islands there occur besides *Sag. bedfordii* and *Sag. neglecta* in a small number (TOKIOKA 1942). Most of *Sag. neglecta* recorded by R. MAURICE (1953) from lagoons of Takapato, Takaroa, Takume and Hikuem of the Tuamotu Islands are very probably *Sag. oceanica.* The material of the Great Barrier Reef Expedition collected inside the reef near Low Island consists chiefly of *Sag. enflata*, next *Sag. neglecta* and *Sag. robusta* and followed by *Sag. bedoti, Sag. pulchra* and *Sag. serratodentata* (BURFIELD 1950).

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PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XIII. THE PLANKTON OF OBAMA BAY ON THE JAPAN SEA COAST[1]

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Seto Marine Biological Laboratory, Sirahama

With 9 Text-figures

As to the benthic and foraminiferal communities of Obama Bay, three papers have already been published by Habe *et al* (1945 and 1946) and Morishima (1948) respectively. The writer made a plankton survey of the same bay on October 19 th, 1953. The field work was carried out with the help of gentlemen of Obama Fisheries High School to whom the writer wishes to express his hearty thanks. He is also indebted to Prof. D. Miyadi, Dr. H. Utinomi and Dr. T. Tokioka for advices and valuable suggestions in preparing this paper.

Hydrological Conditions

Obama Bay is a small baylet on the southern coast of Wakasa Bay (Fig. 1). It is about 15 km long in the E—W and 7 km in the N—S direction, and has a rather narrow entrance (about 2.5 km across) between the capes Nokogiri-saki and Matuga-saki. The entrance is about 30 m deep, while the central area of the bay is 10–20 m deep; Aoto-inlet on the west and Nisizu-inlet on the east are largely less than 10 m deep. A small river, consisting of two branches Kita- and Minamigawa, flows into the bay from the southern coast of Nisizu-inlet.

Water temperature (Fig. 2, A): The water temperature at the surface was varied from 20.8°C to 22.5°C, a little lower in the western Aoto-inlet to the southern coast than in the central area and in the eastern Nisizu-inlet.

Salinity (Fig. 2, B and C): The salinity in the surface layer was a little lower in both inlets where a small river pours into the bay than in the central part of the bay. In the 5 m layer it was uniformly higher than at the surface, ranging from 31.5 to 32.3 ‰, although it was nearly the same in both layers at the western Aoto-inlet (30 to 31 ‰).

1) Contributions from the Seto Marine Biological Laboratory, No. 243.

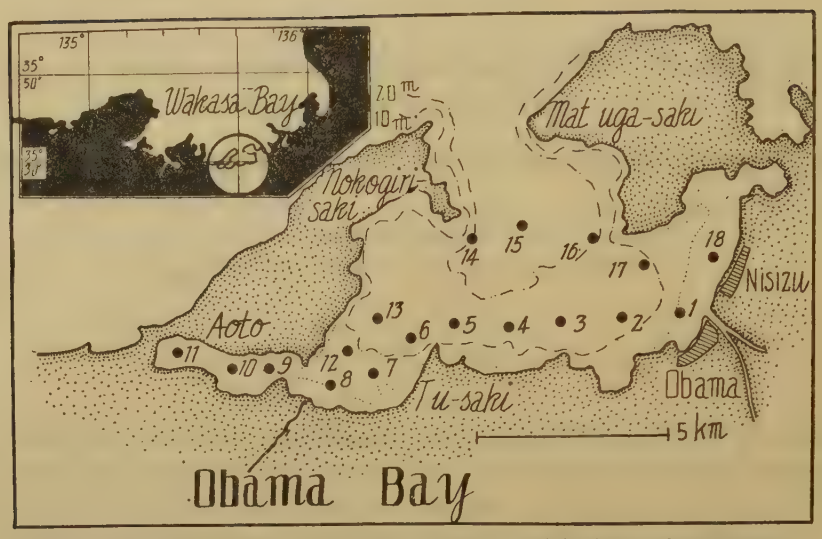

Fig. 1. Map of Obama Bay showing stations and bathymetric contours.

Transparency (Fig. 2, D): The transparency of water was very small at all stations, measuring only 1.5–5 m, particularly smaller in both inlets.

Catalytic activity of sea water (Fig. 3, A and B): At the surface of the western Aoto-inlet the activity was less than that at the surface of the eastern inlet, except at stations near the estuary. In the central area of the bay it was relatively low. In the 5 m layer the activity was relatively higher than at the surface.

Plankton

A. Quantitative Analysis of Plankton

The settling volume of plankton in this bay was lower than in Turuga Bay, as varied from 0.01 to 0.05 cc per one meter haul (Fig. 3, C), and was larger in the Nisizu- and Aoto-inlets than in the central area of the bay. The total number of individuals, cells or colonies of the plankton was largest in the eastern inlet, being about 6 thousands per one meter haul. The smallest number was measured in the western inlet, where the diatoms were especially scarce (Fig. 3, D and Fig. 5, B). Fig. 5, A (above) shows in a graphical form the correlation between the settling volume and total number of plankton per one meter haul. The two curves each for number and volume, are nearly parallel except in the eastern (Sts. 1 and 18) and western inlets (Sts. 8, 9, 10, 11 and 12), where the zooplankton was markedly richer in number as well as in volume (Fig. 5, A and B). The zooplankton was evenly scarce in the central area of the bay, being 100–300 individuals per one meter haul. The phytoplankton was richest in the mouth of the eastern inlet and decreased towards

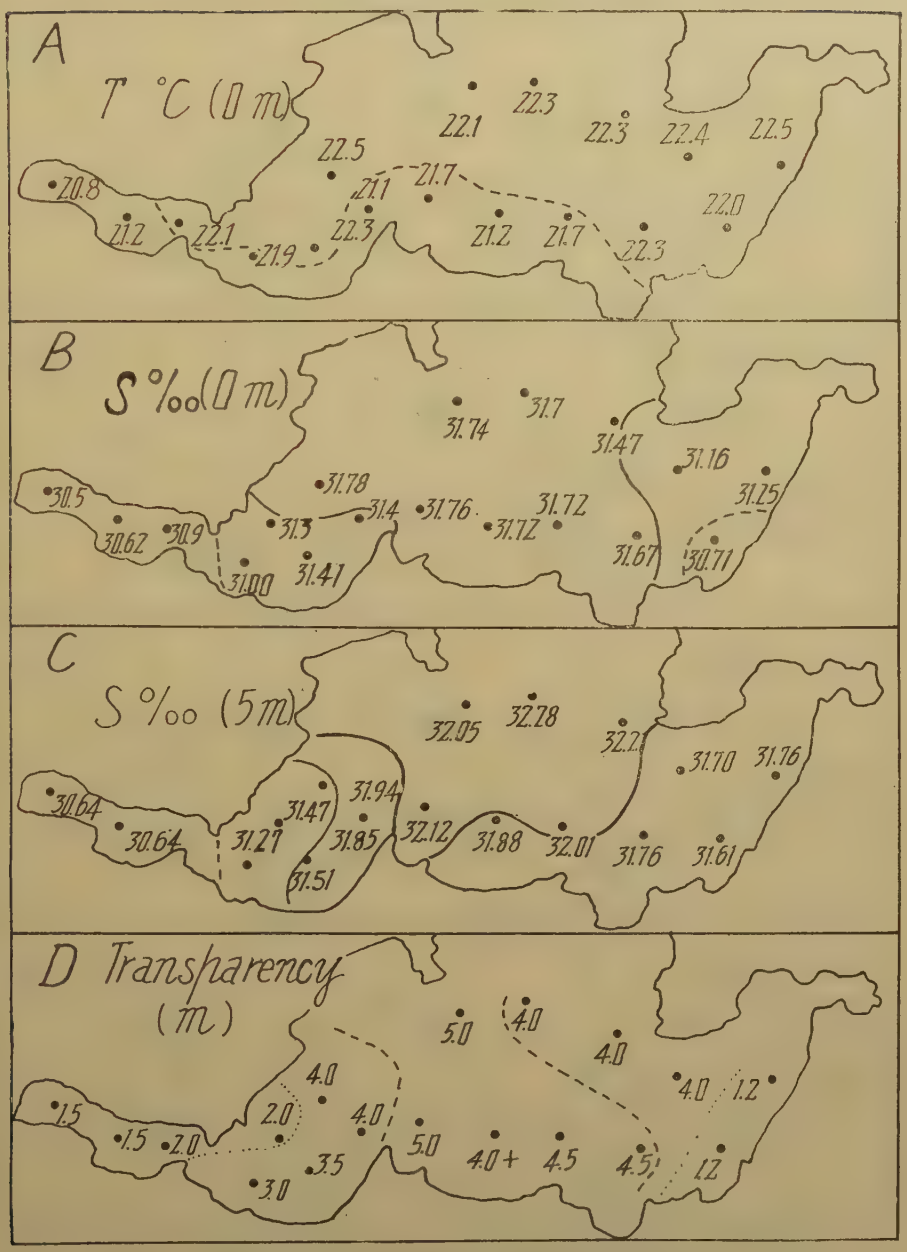

Fig. 2. Distribution of hydrological conditions.
A. Water temperature at the surface.
B. Salinity at the surface.
C. Salinity in the 5 m layer.
D. Transparency.

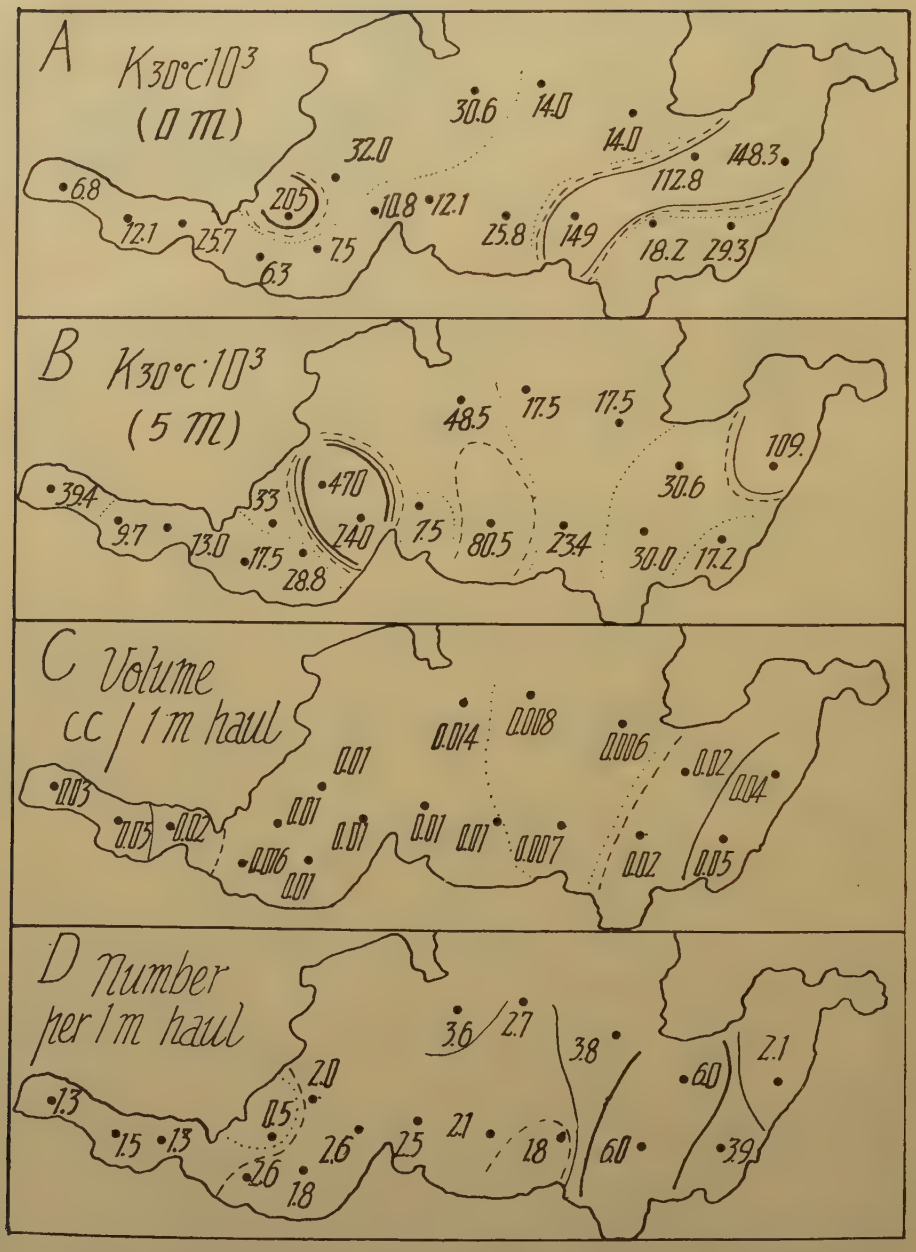

Fig. 3. Distribution of catalytic activity of sea water at the surface (A) and the 5 m layer (B).
Settling volume of plankton per one meter haul from the bottom to the surface (C) and total number of plankton (Unit of number is thousand) (D).

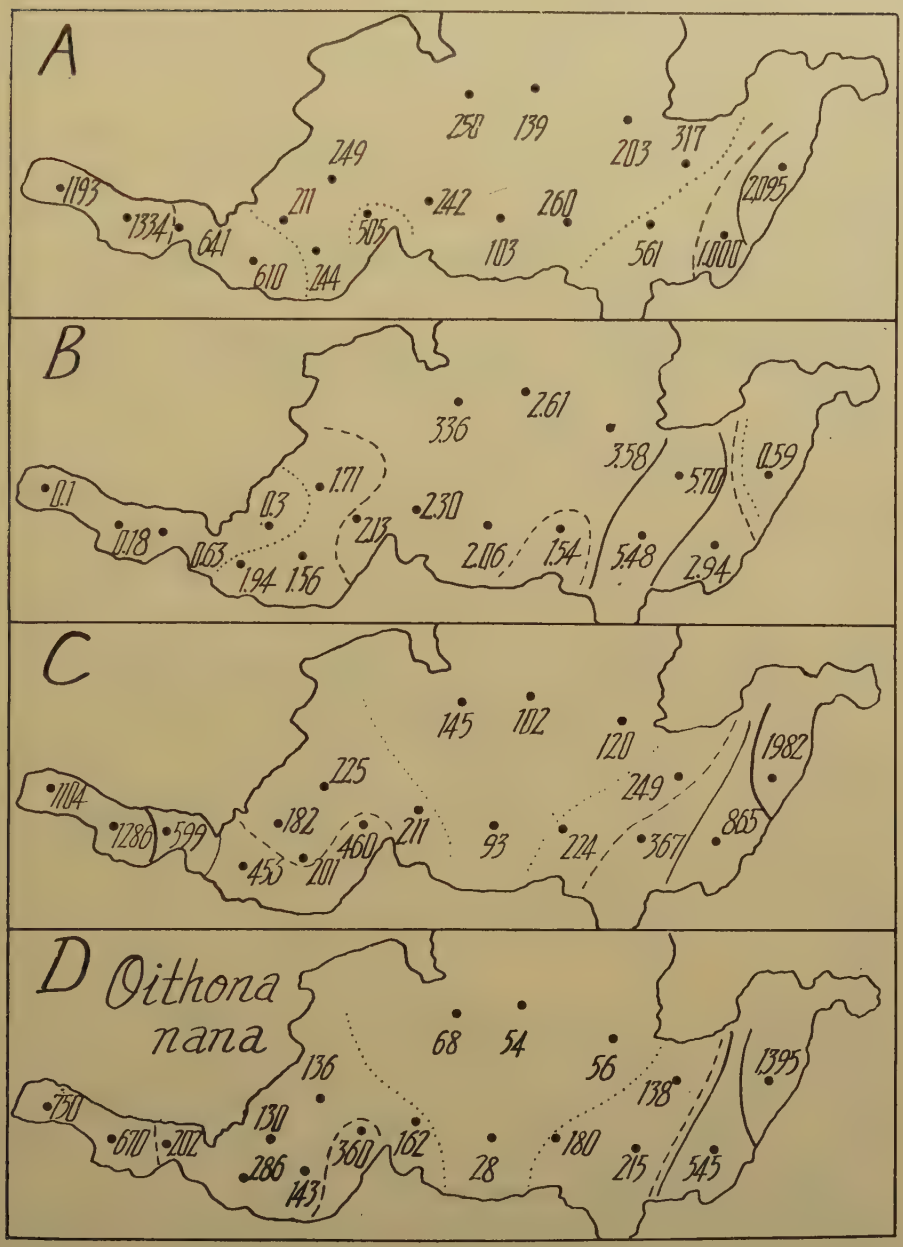

Fig. 4. A. Distribution of total number of zooplankton per one meter haul.
B. Total number of cells or colonies of phytoplankton.
C. Total number of copepods.
D. Distribution of a copepod *Oithona nana*.

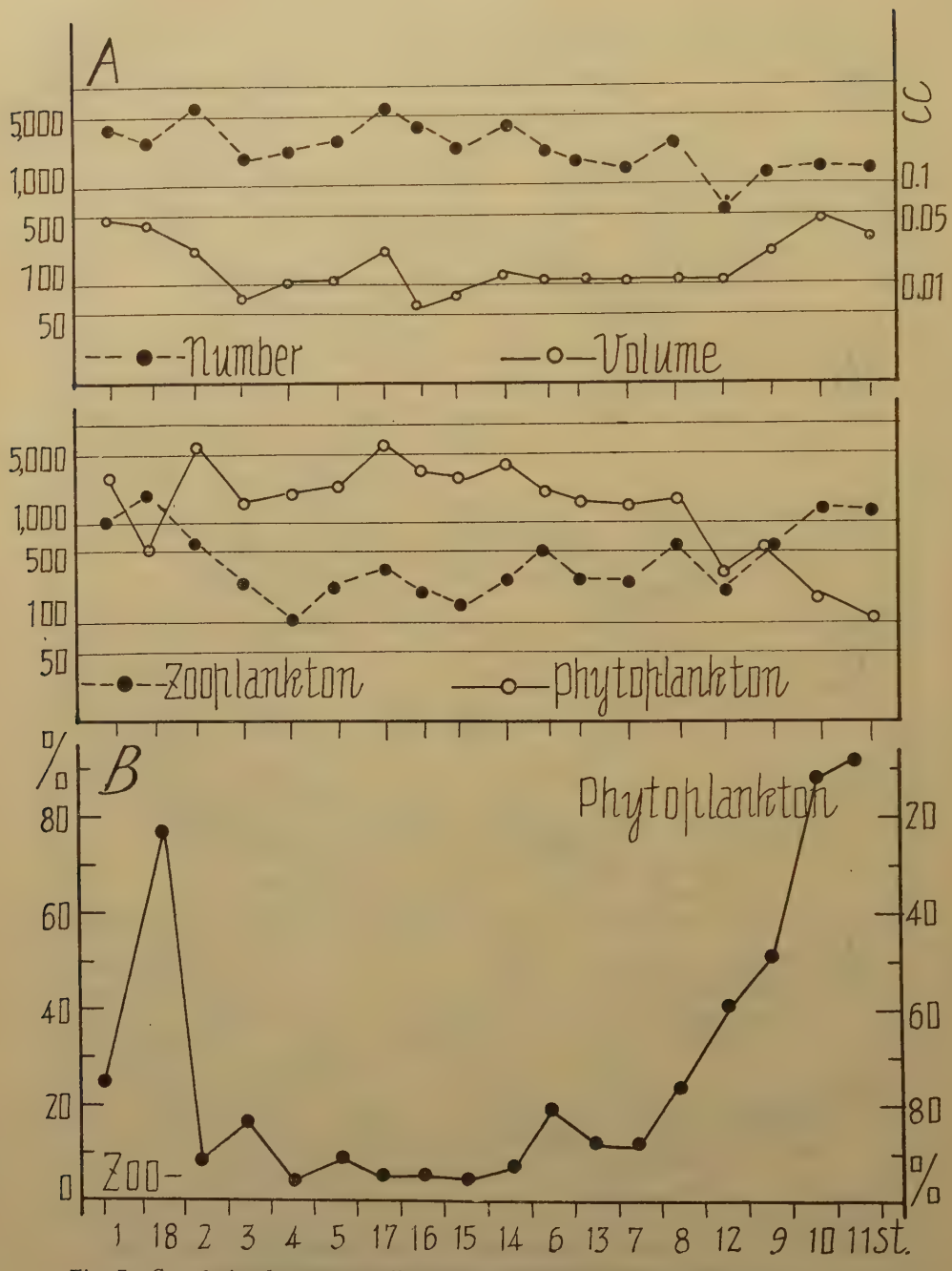

Fig. 5. Correlation between settling volume and total number of plankton in the bay (A, above) and that between total number of zoo- and phytoplankton (A, below). Percentage composition of zoo- and phytoplankton (B).

the mouth and western inlet of the bay. The numerical percentage of zooplankton in total plankton was very large in both inlets; it showed 20–80 % in the eastern inlet and 8–90 % in the western inlet (Fig. 5, B). While it was smallest in the central area, only 4–10 %.

Quantitative Analysis of Plankton

Zooplankton

The copepods, larval forms, protozoans and other animals, including cladocerans, tunicates, chaetognaths and medusae, were dominant groups among zooplankton. Copepods were represented by 90 % of total zooplankton at Sts. 18, 4, 6, 13, 9, 10 and 11, by 80 % at Sts. 1, 3, 4, 5, 7, 8, 12 and 17, and by 60 % at Sts. 2, 4 and 16 (Fig. 6, bottom). Of copepods, *Oithona nana* and *Paracalanus parvus* were most abundant throughout the stations. Other copepods were only less than 10 %, they were *Acartia clausi*, *A. spinicauda*, *Euterpe acutifrons*, *Oithona similis*, *Microsetella norvegica*, *Micro. rosea*, *Oncaea venusta*, *O. media* and *Corycaeus* sp.

Oithona nana was as usual more numerous in the inlets than elsewhere, and it was represented by 50 to 80 % of total copepods at almost all stations (Fig. 4, D and Fig. 8).

Paracalanus parvus, more stenohaline than *Oithona nana*, was similarly distributed in the bay, and densest in both inlets.

Acartia clausi and *A. spinicauda* which are principally inhabitants in somewhat estuarine waters of inner bays such as Kozima Bay (Yamazi, 1954a), were very scarce in this bay, although they occurred widely (Fig. 7, B).

Microsetella norvegica, *M. rosea* and *Euterpe acutifrons* were very small in number and percentage composition (Fig. 7, C and D). The other copepods, such as *Calanus minor*, *Oithona plumifera*, *Oncaea venusta*, *Oncaea media*, *Corycaeus flaccus* and *Corycaeus* sp. were sparse. The fact that these species as well as *O. similis* and *Microsetella* were found only in the central area of the bay suggests that they were immigrants from the outer bay, namely Wakasa bay.

Phytoplankton

The Phytoplankton was very poor throughout the stations as compared with the zooplankton, being only less than 6 thousands per one meter haul even at the richest station (St. 17). The main diatom species in the bay were *Thalassionema nitzschioides* (100–1500), *Nitzschia seriata* (less than 300), *Chaetoceros didymus* (less than 1000), *Ch. Lorenzianus* (less than 300), *Ch. curvisetus* and *Bac. hyalinum*. The other 24 diatoms were all neritic species and occurred very sparsely. The dinoflagellates were also poor in number. The main species were *Cer. trichoceros* (less than 100), *C. molle* (less than 25), *C. tripos* (less than 30), *C. pennatum* (less than 15), *C. fusus* (less than 30) and small number of *Pyrocystis noctiluca*, *Peridinium grande*, *P. depressum*, *P. oceanicum* var. *oblongum*, *C. palmatum* var. *ranipes*, *C. candelabrum*, *C. smatoranum* and *Ceratocorys horrida*.

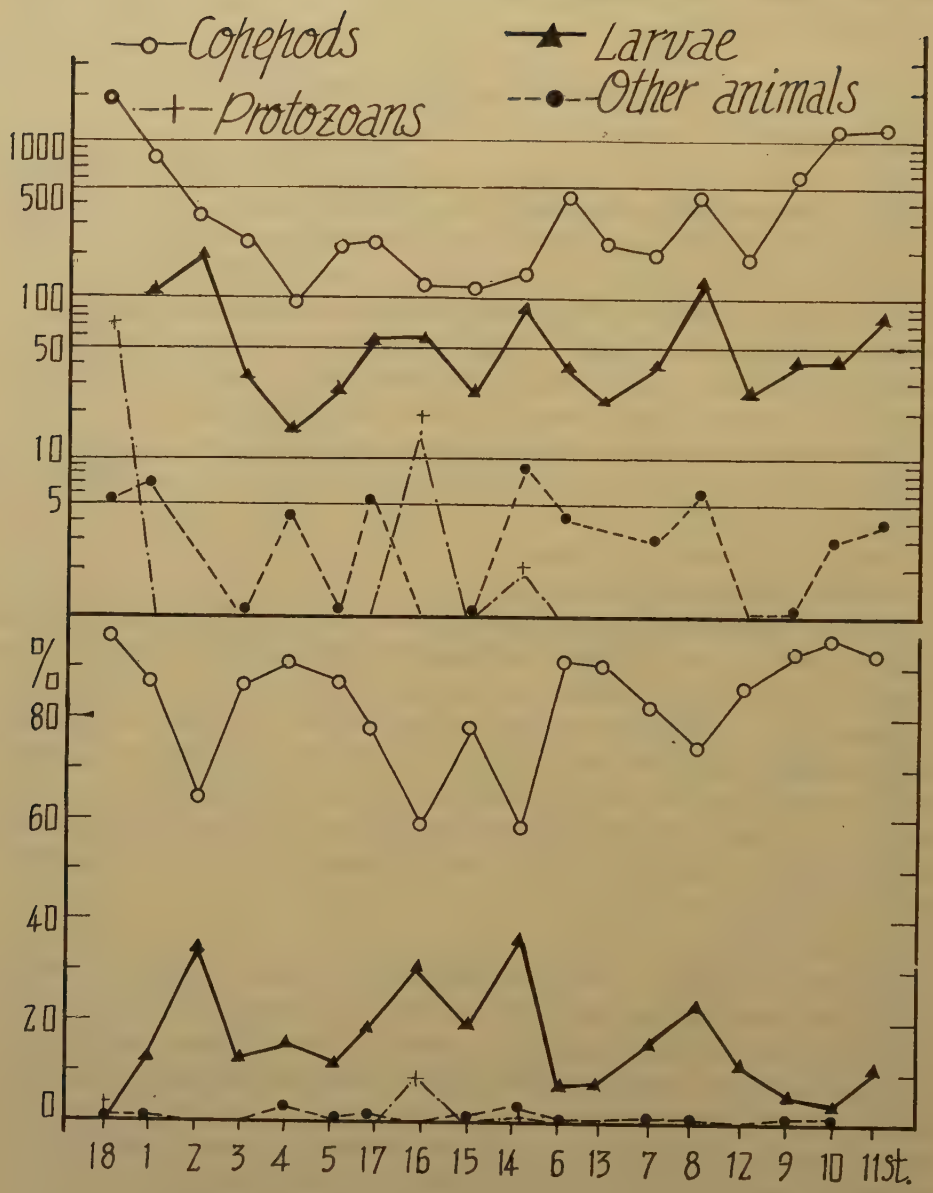

Fig. 6. Population of zooplankton groups per one meter haul (above) and their percentage composition (below).

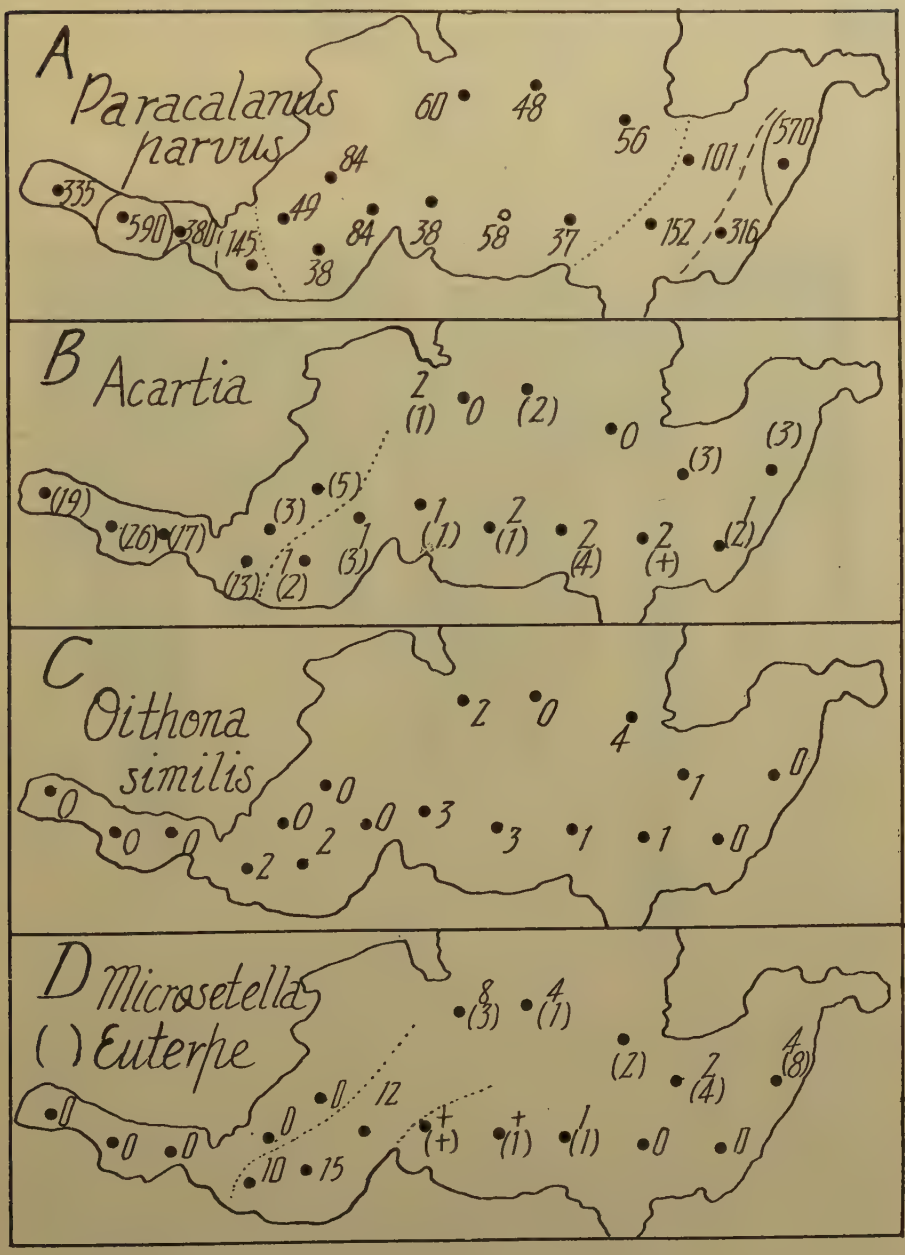

Fig. 7. Distribution of important copepods.

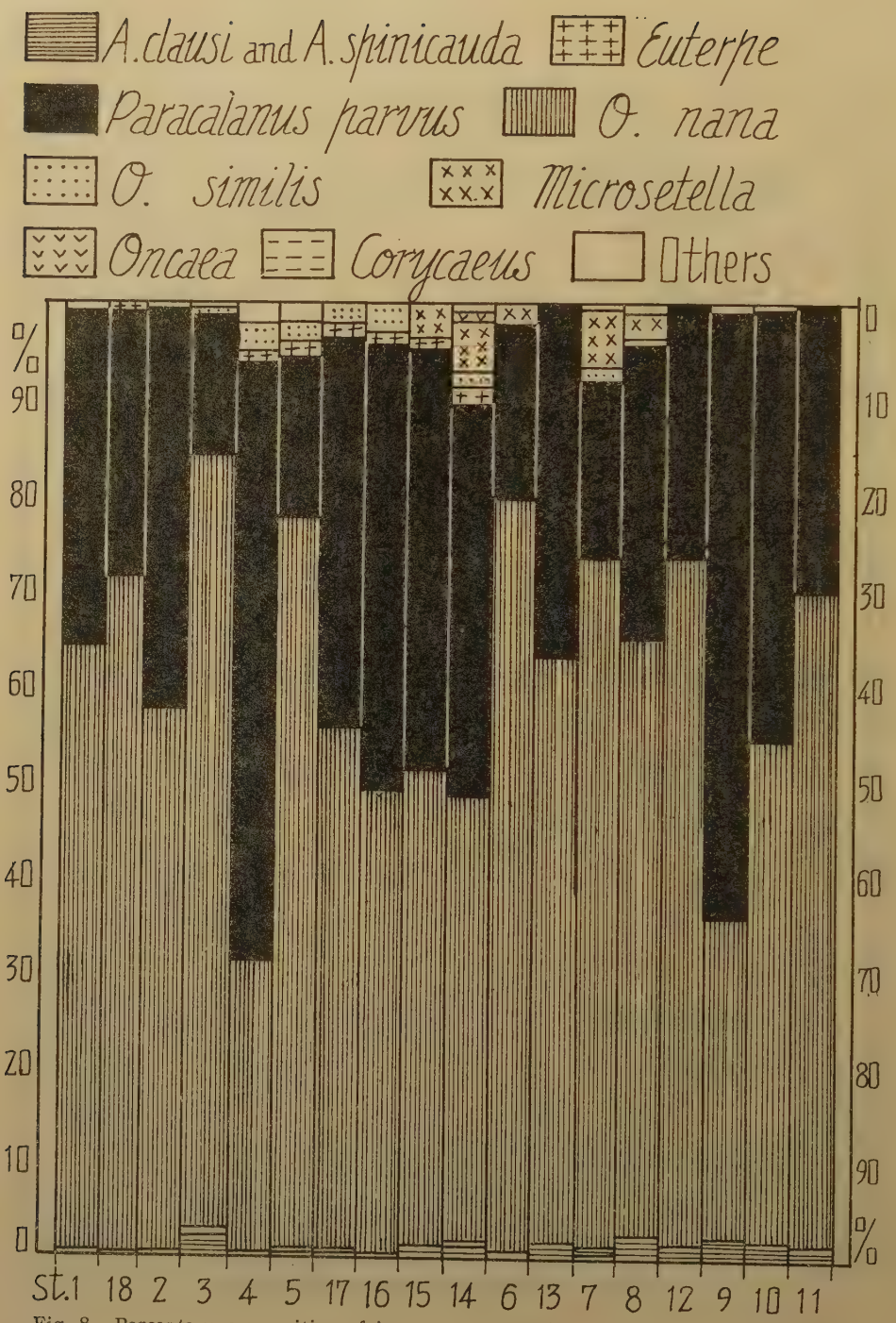

Fig. 8. Percentage composition of important copepods per one meter haul at each station of the bay.

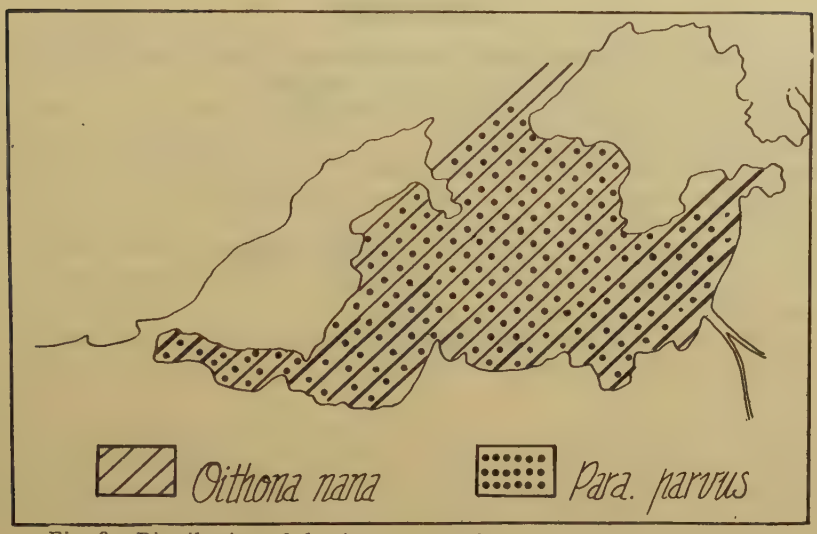

Fig. 9. Distribution of dominant copepod communities in Obama Bay.

Consideration and Conclusion

Obama Bay is a secondary baylet of a large-sized Wakasa Bay. Its entrance is narrow, so that the water in the bay is relatively stagnant. The plankton components in the bay are also different from those of the open sea water. The most important plankton in the bay is copepods, and the distribution of the dominant copepods in percentage composition and their number shows that the copepod fauna of the bay may be safely recognized as *Oithona nana–Paracalanus parvus* community, in which the following two faciations are discernible on differences found in the distribution of associate plankters:

The narrow areas of the western and eastern inlets showing low salinity and small transparency are occupied densely by *Oithona nana*. This copepod is associated with a large number of copepod nauplii, *Paracalanus parvus* and a small number of *A. clausi*, *A. spinicauda*, *Euterpe acutifrons* and *Oithona similis*. The diatoms and dinoflagellates are few in number.

The central area of the bay is also occupied by *Oithona nana–Paracalanus parvus* mixture nearly in the same percentage composition as in the first faciation, but here some oceanic dinoflagellates are relatively larger. The population density in this area is smaller than in two inlet areas, although number of species is larger. The water of this area is rather similar to that of the inner region of Wakasa Bay (YAMAZI, 1954 b) and shows slightly higher salinity than in two inner inlets as mentioned previously.

Furthermore it may be noticeable that the two estuarine species *Acartia clausi* and *A. spinicauda* are widely distributed in nearly the whole area of the bay, although few in number.

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PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XIV. THE PLANKTON OF TURUGA BAY ON THE JAPAN SEA COAST[1)]

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With 11 Text-figures

The plankton survey was carried out on Oct. 19th, 1953, namely on the same day when another survey was made in Obama Bay. The samples were collected at the superficial and the 5 meter layers at each of 15 stations (Fig. 1). The methods of surveying and examining the material are similar to those described in previous papers. The writer is much indebted to the Director and staff members of Fukui Prefectural Fisheries Experimental Station for allowing me to use the research boat for the collection of samples, and here he wishes to express his hearty thanks for their kindness.

Hydrological Conditions

Turuga Bay is a small inlet, situated at the eastern corner of Wakasa Bay (Fig. 1). The bay is nearly wedge-shaped in outline, and has a wide mouth. The basin is very steep, thus the 20 m isobath line running near the shore. The water temperature of the 0 m and the 5 m layers is shown in Fig. 2, A and B. The salinity (Fig. 3, A) of the superficial layer varied from 30.5 to 32.6‰, and was lower in the inner part and the eastern area of the bay, because the low saline water was transported there from the inner part by current and wind. At the 5 m layer (Fig. 3, B) it was uniform and 32–32.7‰ were found at all stations.

The transparency of water was larger than in Obama Bay (Fig. 2, C). It was largest in the western area of the mouth (about 17.5 m) and decreased towards the inner part of the bay (from 14 m to 4 m). The water of the eastern part was less transparent than in the western part.

The highest concentration of silicates (SiO_2) (Fig. 3, C) occurred in the inner part, while the lowest was in the eastern area near the mouth. The contents of SiO_2 varied from 700 to 4,500 mg per m^3 at the superficial layer and from 1,500 to 2,500

1) Contributions from the Seto Marine Biological Laboratory, No. 244.

mg/m³ at the 5 m layer.

The catalytic activity of sea water at the surface showed higher values in the western area of the mouth and inner part of the bay. The minimum values were extending along the western part of the central region. At the 5 m layer it was higher than that at the surface. The maximum value was found in the area extending

Fig. 1. Map of Turuga Bay showing stations and bathymetric contours.

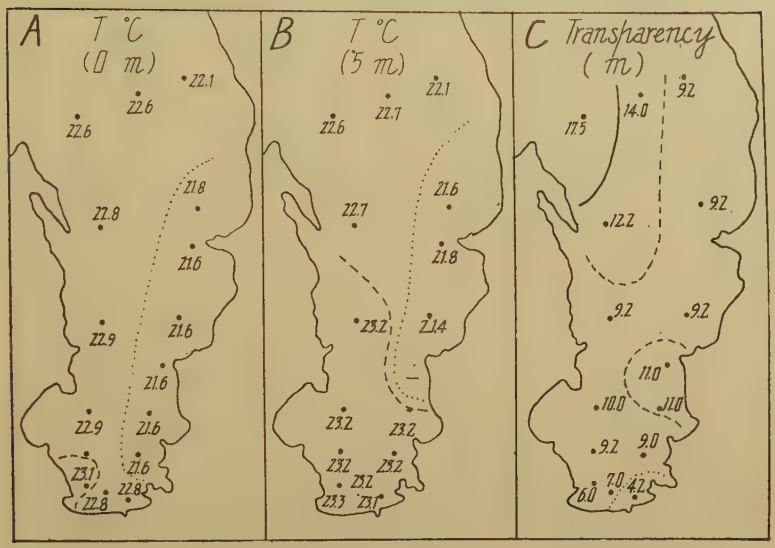

Fig. 2. Distribution of water temperature (A and B) and transparency (C).

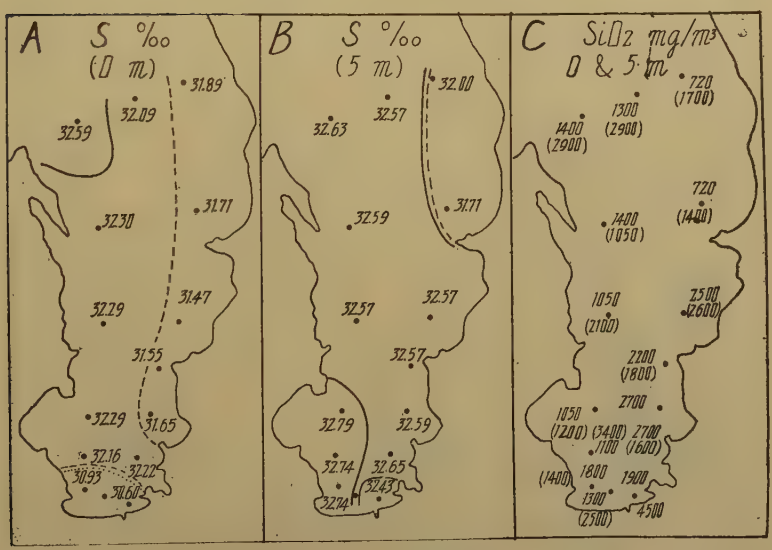

Fig. 3. Distribution of salinity at the surface (A) and 5 m layer (B) and silicates (SiO_2 mg/m^3) at the 0 m and 5 m layers(C).

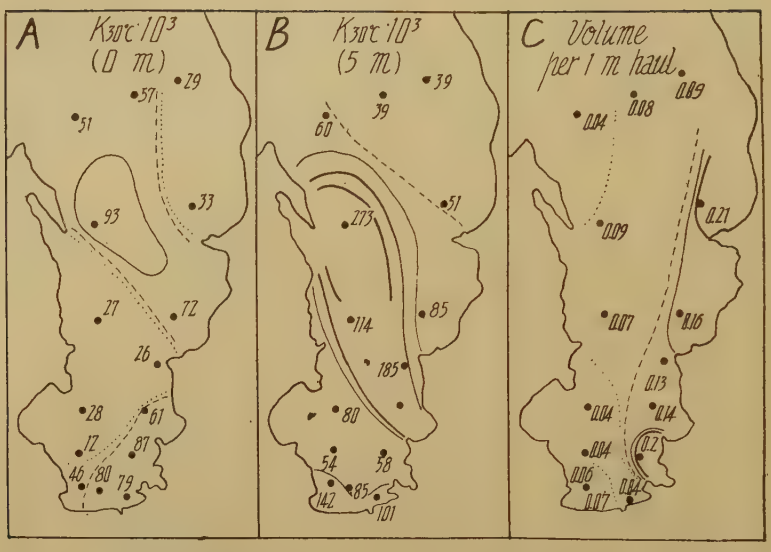

Fig. 4. Distribution of catalytic activity of sea water (A and B) and settling volume (cc) of plankton per one meter haul from 15 m layer or bottom to the surface (C).

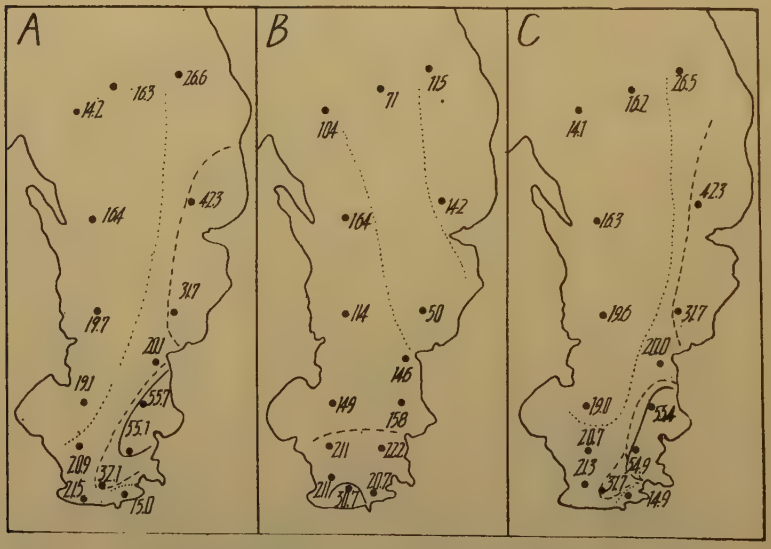

Fig. 5. A. Total number of plankton individuals, cells, or colonies per one meter haul (Unit of number is thousand).
B. Total number of zooplankton individuals per one meter haul.
C. Total number of phytoplankton per one meter haul (Unit of number is thousand).

from the western part of the mouth to the southeastern part of the bay and was about twice as high as observed in the same area at the 0 m layer (Fig. 4, A and B).

Plankton

A. Quantitative Analysis of Plankton

The plankton samples were hauled by the same method as used in Obama Bay (YAMAZI, 1954 b). The settling volume was larger than in Obama Bay. It varied between 0.04 and 0.21 cc per one meter haul, showing higher values in the eastern

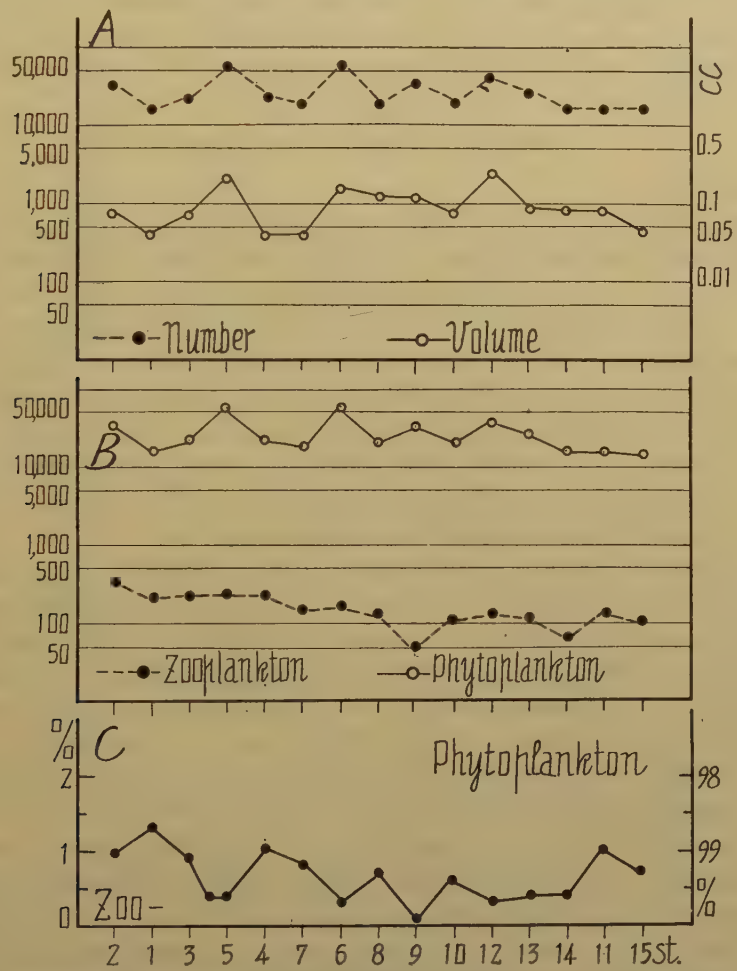

Fig. 6. A. Relation between settling volume and total number of plankton per one meter haul.
B. Distributional graph of total number of zoo- and phytoplankton.
C. Percentage composition of zoo- and phytoplankton.

area. The total number of plankton was also of the same case as the settling volume. The maximum occurred in the inner part of the eastern area (Fig. 5, A), where the number reached 55 thousands per one meter haul, while the minimum in the western area was 14 thousands.

The curves for volume and number distributions are given graphically in Fig. 6, A. There is a close parallelism between volume and total number at each station. This is clearly due to the similar components qualitatively. As shown in Fig. 6, B, the maximum number of zooplankton was found in the inner part and the minimum in the mouth; the maximum number of phytoplankton caused by dense diatoms was obtained from the eastern area of the inner part. The numerical percentage of zooplankton in total plankton was very small, less than 1%. It decreased towards the outer part and the eastern part of the bay. (Fig. 6, C).

B. Qualitative Analysis of Plankton

ZOOPLANKTON

The main components of zooplankton were copepods (40–80%), larvae (20–70%), protozoans (0–8%) and other animals (1–10%). The components of these groups varied at each station, but they were densest in the innermost region and decreased towards the outer region of the bay (Fig. 7, A and B). Of copepods, *Oithona nana* and *Paracalanus parvus* were by far the most dominant species even in the inner region, although less numerous in the several stations near the mouth. Other copepods comprising 1–40% of all copepods were: *Acartia clausi*, *A. spinicauda*, *Euterpe acutifrons*, *Oithona similis*, *Microsetella norvegica*, *Oncaea media*, *Oncaea venusta*, *Corycaeus* sp., *Calanus minor*, *Cal. tenuicornis*, *Calocalanus pavo*, *Eucal. attenuatus*, *Centropages bradyi*, *Oithona plumifera* and *Candacia* sp.

Oithona nana occupied 60–80% of copepods in the inner region, 50% in the eastern area and 15–20% in the mouth. *Paracalanus parvus* occupied 20–40% in the inner region and decreased towards the outer region of the bay (Fig. 8, B, C and Fig. 10). Other copepods showed higher percentages than in Obama Bay. Of these, *Acartia clausi* and *A. spinicauda* were restricted to the innermost region more clearly than *Oithona nana* and *Paracalanus*, although they occurred in very low percentages. Other species were found very sparsely, but they occurred richer in the outer part than in the inner part (Figs. 8, 9 and 10).

Penilia schmackeri was found widely, but never plentifully. *Podon* sp. was caught scarcely in the outer part of the bay. Neritic chaetognath *Sagitta delicata* and oceanic chaetognath *S. enflata* were also represented by only a few individuals at each station. Of the tunicates, *Oikopleura dioica*, *O. longicauda* and *Fritillaria* sp. were sparsely found. A siphonophora, *Muggiaea atlantica*, and some hydromedusae were found in small number near the mouth.

Larval forms were important components of the plankton in the bay, although only copepod nauplii were found abundantly throughout the stations (Fig. 7, A

and Fig. 9, C). Copepod nauplii were most numerous in the inner part of the bay and decreased towards the outer part. The larval forms of bottom animals were polychaete larvae, gastropod veligers, pelecypod veligers, cirripede nauplii, auricularia, ophiopluteus, actinotrocha and pilidium. The pelecypod veligers were found relatively richly from the inner to the eastern areas (10–50 individuals per one meter haul), while the gastropod veligers were never found in great abundance. The polychaete larvae were recorded at almost all stations and numbered from 2 to 8 individuals.

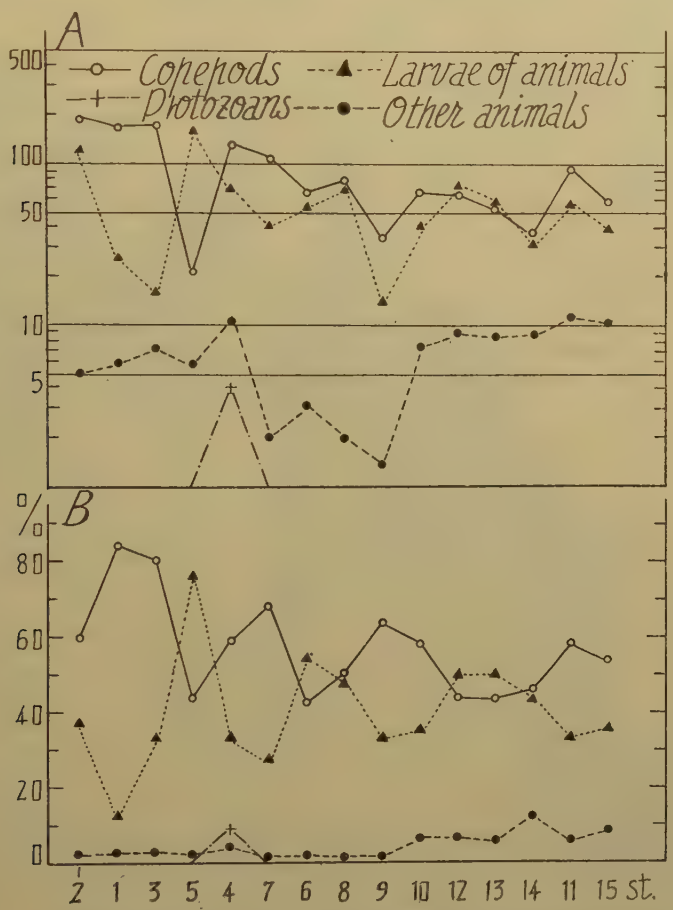

Fig. 7. Number of zooplankton groups per one meter haul (A) and their percentage composition.

PHYTOPLANKTON

Diatoms were richer than in Obama Bay. Their populations were larger in the inner and eastern areas of the bay than in the western area, although the components at each station were almost similar. The dominant diatoms were mostly neritic species, such as *Chaetoceros Lorenzianus* (4–13 thousands), *Ch. didymus* (1–7 thousands),

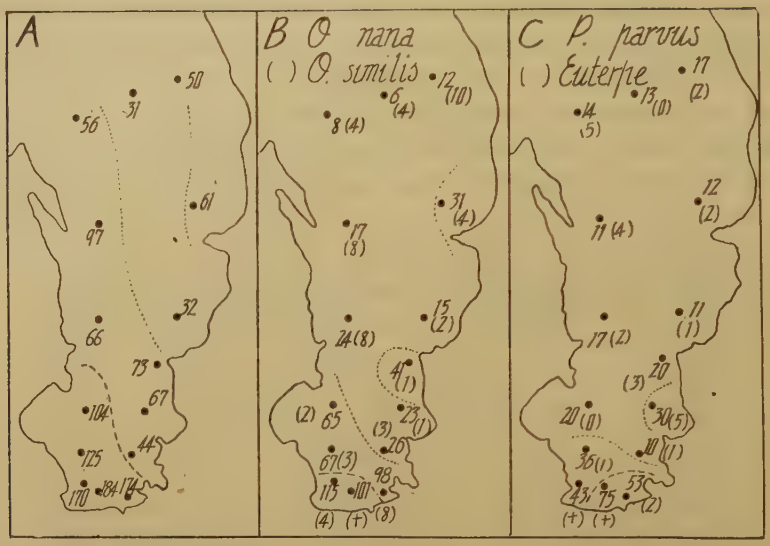

Fig. 8. Distribution of total number of copepods per one meter haul (A) and four important copepods in the bay (B, C).

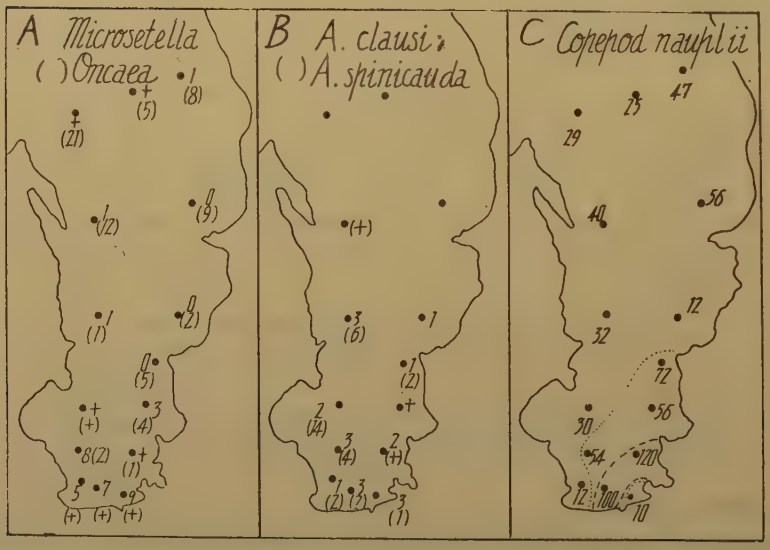

Fig. 9. Distribution of four important copepods (A, B) and copepod nauplii (C).

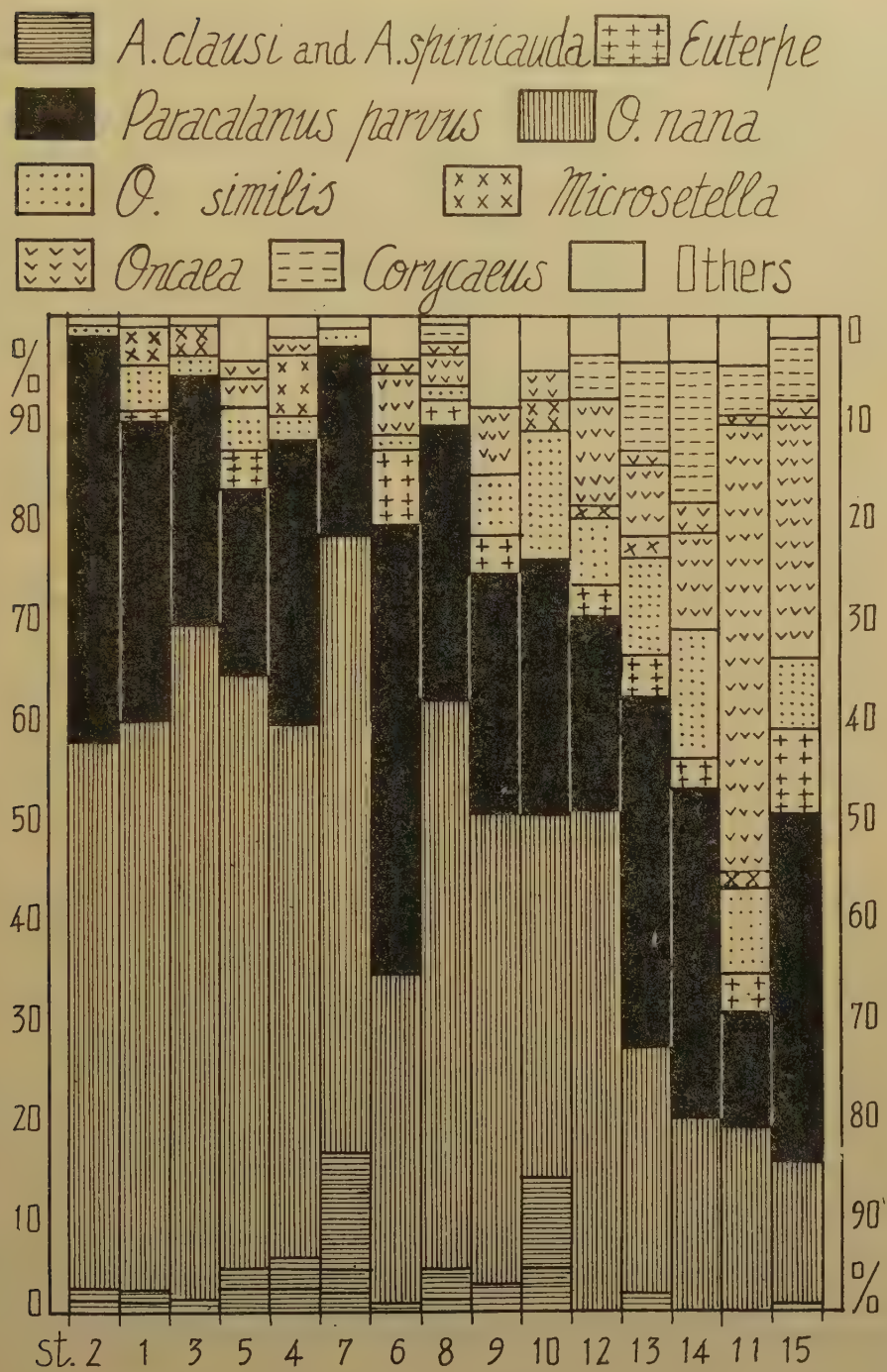

Fig. 10. Percentage composition of important copepods.

Ch. decipiens (less than 3 thousands), *Ch. affinis* (less than 10 thousands), *Ch. curvisetus* (less than 7 thousands), *Ch. laciniosus* (less than 8 thousands), *Rhizosolenia setigera* (less than 0.8 thousands), *Rh. alata* f. *gracillima* (less than 0.2 th.), *Bacteriastrum hyalinum* (0.1–13 th.), *Thalassiothrix Frauenfeldii* (1–4 th.), *Thalassionema nitzschioides* (1–5 th.), *Thalassiothrix longissima* (less than 0.4 th.), and *Nitzschia seriata* (less than 3 th.). A small number of oceanic forms, such as *Rh. calcar avis*, *Rh. Bergonii*, *Rh. hebetata*, *Rh. styliformis* var. *latissima*, *Ch. coarctatus*, *Ch. denticulatus*, *Ch. atlanticus* var. *neapolitana*, *Ch. peruvianus*, *Ch. messanensis*, *Climacodium biconcavum* and *Ditylum sol* were found widely. *Asterionella japonica*, *Nitzschia longissima*, *Nit. delicatissima*, *Hemiaulus Hauckii*, *Bidd. longicruris*, *Bidd. sinensis*, *Stephanopyxis Palmeriana*, *Dac. antarcticus*, *Bac. delicatulum*, *Leptocylindrus danicus*, *Ch. willii*, *Ch. laevis*, *Ch. Eibenii* etc. occurred, but very sparsely.

Dinoflagellates were quantitatively very scarce, although rich in number of species. They were *Ceratium trichoceros* (less than 300), *C. extensum* (less than 100), *C. deflexum* (less than 40) *C. fusus* (less than 50), *C. tripos* (less than 100), and a small number of *Pyrophacus horologicum*, *Oxytoxum* sp., *Pyrocystis noctiluca*, *Pyr. fusiformis*, *Peridinium grande*, *Per. depressum*, *Ceratocorys horrida*, *Ceratium furca*, *C. macroceros*, *C. masciliense*, *C. smatoranum* var. *angulatum*, *C. gibberum* f. *sinistrum*, *C. molle*, *C. candelabrum*, *C. carriense* f. *caylanicum*, *C. palmatum* var. *ranipes* etc. Thus the general features about diatoms and dinoflagellates were: 1) both neritic and oceanic forms were distributed in the whole area of the bay; 2) oceanic forms were relatively rich; and 3) diatoms were richer in the inner part along the eastern half in the bay than in the western half.

Consideration and Conclusion

The basin of Turuga Bay is largely deep and gradually shallower towards the inner part of the bay. This topographical feature closely resemble that of Miyako Bay on the Sanriku coast of Tôhoku district (YAMAZI, 1954 b). The salinity at the surface and the transparency of water are slightly lower in the inner and eastern area of the bay, though the salinity at the 5 m strata is uniform throughout the stations. The productivity of plankton is higher in the inner and eastern area of the bay. The bay is also characterized by the relatively richer oceanic forms entered from Wakasa Bay. These species distribute evenly at nearly all stations. The most important component of the zooplankton in this bay is copepods, and its distribution is summarized in Fig. 11.

The inner part and the eastern half of the bay are characterized by the dominance of *Oithona nana* and *Paracalanus parvus* in the percentage composition of copepods. A small number of *A. clausi*, *A. spinicauda*, *Euterpe acutifrons*, *Oithona similis*, *Oncaea venusta*, *Microsetella norvegica* and *M. rosea* and several oceanic copepods are found in the inner part.

The western half and the mouth part are characterized by the abundance of

Fig. 11. Distribution of copepod communities in Turuga Bay.

Oncaea media, *Paracalanus*, *Oithona nana*, together with a small amount of *O. similis*, *Euterpe acutifrons*, *Microsetella*, *Oncaea venusta*, *Calocal. pavo*, *Eucal. attenuatus*, *Centropages*, *Oithona plumifera* and *Candacia* sp. et al, although these oceanic copepods distribute very sparsely in the eastern half. Oceanic tunicates, chaetognaths, diatoms and a large number of oceanic species of dinoflagellates occur widely. They are by far richer in number and penetrating inwards more deeply in this bay as compared with Obama Bay. This is due to the heavy influence of the open sea water. Thus, the regional arrangement of plankton communities cannot be so distinctly recognized as in bays which have each a narrow mouth and are affected only slightly by ocean water.

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PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XV. THE PLANKTON OF YOSA-NAIKAI AND KUMIHAMA BAY, ENCLOSED BAYS ON THE JAPAN SEA COAST[1]

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With 2 Text-figures and 4 Tables

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INTRODUCTION

With the purpose of studying the productivity of the waters and marine organisms in relation to the topographical and hydrological features, a series of surveys of two enclosed bays, i.e. Kumihama Bay and Yosa-Naikai both situated on the Japan Sea

1) Contributions from the Seto Marine Biological Laboratory, No. 245.

coast of Kyoto Prefecture were projected by Prof. Dr. D. MIYADI *et al.* Of these surveys, the hydrological, benthic studies and that of the shell-deposits have already been published (MIYADI, HABE and YAMAZI, 1950; MAÉDA, 1952, 1953, a and b). And here the present paper deals with the plankton samples obtained during these surveys. The samples were collected at each station by a horizontal and vertical haul of a

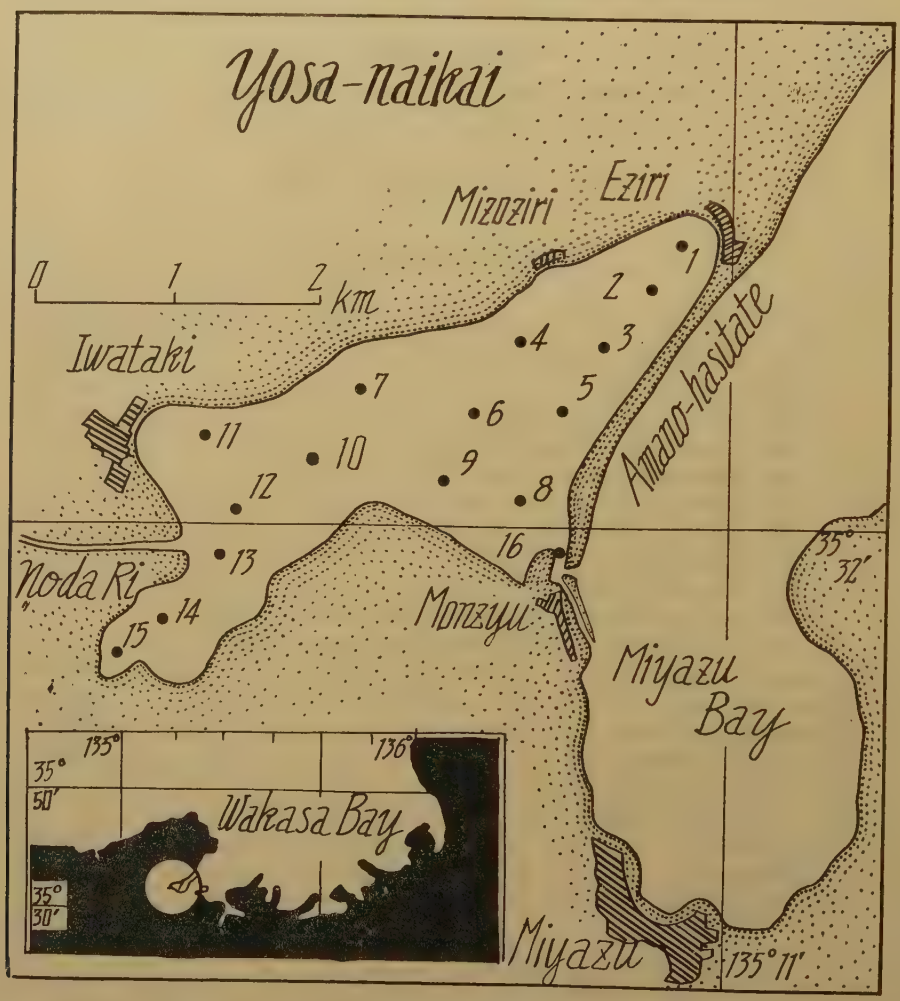

Fig. 1. Map of Yosa-Naikai showing the stations.

net or by taking a liter of sea water using a NANSEN reserving water bottle at each sampling layer. The data of the plankton were discussed in the percentage composition and the total number of plankton per 10 liters of sea water. The materials of Yosa-Naikai were collected at the following stations on the following dates (Fig. 1):

(1) June 4, 1945 (Sts. 1, 6, 8, 10 and 14)

(2) November 25, 1945 (Sts. 5, 6, 7, 9, 12 and 14)
(3) April 4, 1946 (Sts. 6, 6–8, 8 and near channel)
(4) April 20, 1946 (Sts. 2, 8, 10 and 12–13)
(5) November 1, 1946 (Sts. 3, 6 and 12)
(6) June 20, 1947 (14 definite stations)
(7) March 19, 1948 (16 definite stations)

In Kumihama Bay, however, the survey was carried out only once on June 22, 1947 at 24 stations (Fig. 2).

YOSA-NAIKAI

General Hydrological Conditions

Yosa-Naikai is a lagoon of about 5.18 sq. km, separated from Miyazu Bay by a sandbar "Amano-hasidate". The western region near the estuary of the river Noda is relatively shallow measuring less than 10 m in depth, while the eastern region is deeper, being about 13 m in the maximum depth. The water of this lagoon is connected with that of Miyazu Bay by two narrow and shallow channels at the south-eastern corner. This topography and at the same time the shallowness of the tidal amplitude in Japan Sea prevent the active inflow of Miyazu Bay water which is characterized by higher salinity, transparency and dissolved oxygen content and lower silicate and phosphate contents than in the lagoon. Thus, the lagoon water is highly stagnated; the salinity in upper layers is quite low, although it scarcely differs from that of the inner part water of Miyazu Bay (Yosimura, 1938; Miyadi *et al.* 1947, 1949, 1952; Tatibana, 1952; Maéda, 1953). The lower strata of the lagoon are so stable that the oxygen content is very small there or quite absent, and in the latter case a considerable amount of hydrogen sulphide is produced there and seals the lower limit for planktonic and benthonic organisms. Thus, the azoic zone appeared in the lower strata (Miyadi *et al.* 1947, 1949).

Plankton Community

The Plankton on June 4, 1945 (Table 1)

Zooplankton occupied the most part of the plankton in the lagoon. Copepods were represented only by dominant *Oithona nana* and a small number of *Acartia clausi* and *A. spinicanda*. *Oithona nana* showed the highest percentage (60–75%) at each station, *Acartia* was distributed similarly, but less abundant (8–20%). Other animals such as *Sagitta crassa* f. *naikaiensis*, *Oikopleura dioica*, *Evadne nordmanni*, *Favella campanula* and *Noctiluca* etc. were very few throughout the stations. Copepod nauplii were numerous (6–15%), Polychaete larvae (2–5%) and pelecypod veligers (2–7%) occurred also, but in lower percentage. Although these animals and larvae

were recorded merely in small percentage, their appearance in the lagoon in relation to hydrological features seems to be very important ecologically.

The Plankton on November 25, 1945 (Table 1)

Important components of plankton were *Oithona nana* (15–80%), *Acartia clausi* and *A. spinicauda* (13–17%), copepod nauplii (5–15%) and pelecypod veligers (5–8%) as in samples of June. Polychaete larvae, *Sagitta*, *Oikopleura* and *Evadne* etc. were not found at all.

The Plankton on April 4, 1946 (Table 1)

Main components were nearly the same as in the previous surveys, except for that several tintinnids occurred considerably; namely *Tintinnopsis cylindrica* (3–4%), *Tin. radix* (less than 1%), *Tintinnus lusus-undae* var. *tenuis* (1–2%) and *Favella campanula* (1–3%) were widely distributed in the lagoon. *Evadne nordmanni* and *Podon* sp. were also recorded at Sts. 6 and 8 in low percentage.

The Plankton on April 20, 1946 (Table 1)

This time *Oikopleura dioica*, *Podon*, pelecypod and gastropod veligers and tintinnids excepting *Tintinnus lusus-undae* var. *tenuis* were not found in the samples.

The Plankton on November 1, 1946 (Table 1)

The samples were hauled horizontally at 3 stations and vertically at several layers at each station. The dominant species in samples were almost the same as in previous investigations, although they were found in quite different composition. The most remarkable phenomenon was the large population of *Dictyocha fibula*, the maximum density of which reached more than 50 thousands per 10 liters, occurring about 95% of total zooplankton. *Oithona nana* (about 0.2%) and *Acartia* (0.1–0.2%) were very few. Tintinnids comprising *Tintinnus lusus-undae* var. *tenuis*, *Tintinnopsis radix* plus *Tin. cylindrus*, *Favella campanula* were relatively abundant, namely 1.3–2%, 1.5–1.4% and less than 0.1% respectively. *Evadne*, *Penilia* sp. and *Oikopleura dioica* occurred also sparsely.

The Plankton on June 20, 1947 (Table 1)

This time the samples were collected horizontally at 16 stations and vertically at 4 stations (Table 2). The zooplankton was richer in the inner part of Iwataki inlet (Sts. 7, 10, 13, 14; 25,000–28,000 per 10 liters) than in Eziri inlet (Sts. 2, 3 and 4; 1,500–10,000 per 10 liters) and the area near Monzyu (Sts. 8, 6 and 9; 1,480–12,000 per 10 liters). The important components of zooplankton were copepods (30–90%), tintinnids (0.1–5%), larval forms (7–90%) and other animals (less than 0.5%). The representatives of copepods were *Oithona nana* (less than 10,000 per 10 liter, less than

40% in Eziri inlet, and 700–3,000, 20–40% near Monzyu) and *Acartia* (less than 150; less than 5%). *Tintinnopsis radix* and *T. cylindrica* were widely distributed, but in a small number. Copepod nauplii and copepodids were generally the most abundant plankters throughout the stations and always occurred in high percentage in zooplankton. Polychaete larvae occurred sparsely. The phytoplankton was little in quantity and distributed rather unevenly.

The Plankton on March 19, 1948 (Table 1)

The plankton was collected at 14 stations. It was a rich copepod plus tintinnid community and consisted of 5–35% of copepods and 30–85% tintinnids. Of these animals the following were the predominant members: *Oithona nana* (2–32%), *Acartia* (1–16%), *Centropages* (0–5%), *Paracalanus parvus* (0–10%), *Tintinnopsis cylindrica* (8–59%) and *T. radix* (0–4%), *Tintinnus lusus-undae* var. *tenuis* (1–42%), *Helicostomella longa* (3–31%) and *Favella campanula* (less than 4%). *Acartia clausi* was more abundant than *Oithona nana* at nearly all stations in this spring season. *Paracalanus parvus* was found only near Monzyu (Sts. 6, 8, 9 and in the channels) and considered to be brought into the lagoon from Miyazu Bay. Tintinnids occurred widely throughout the stations. Larval forms were represented by copepod nauplii (2–20%), polychaete larvae (1–20%) and a small number of pelecypod veligers.

Vertical Distribution of Zooplankton on November 1, 1946

The samples were collected vertically at Sts. 3, 6 and 12 during the day time. The distribution of important zooplankton is shown in Table 2.

Oithona nana distributed from the surface to the 6 m layer. Its number increased at first with depth, and attained to the minimum near the 5–6 m layer at Sts. 3 and 6. Beneath the maximum layer it then decreased with depth and disappeared at the 9 m layer at St. 3, the 12 m layer at St. 6 and 11 m layer at St. 12. The distribution of *Acartia* showed the same tendency, although the population was relatively small. The lower limit of the distribution of polychaete larvae lied at the same depth as in the case of copepods. The larvae were, however, condensed most densely at the 7 m layer at St. 3, the 6 m layer at St. 6 and the 10 m layer at St. 12, where *Oithona* and *Acartia* already passed the maximum layer and decreased to a small number. An enormous quantity of tintinnids, such as *Tintinnopsis cylindrica*, *Tintinnus lusus-undae* var. *tenuis*, *Favella campanula*, distributed densely in the superficial layer, but decreased gradually with depth and disappeared at three stations at the 9, 12 and 11 m layers respectively. Thus the lower limit of plankton distribution was determined clearly.

Vertical Distribution of Zooplankton on June 20, 1947 (Table 2)

The plankton was vertically hauled at Sts. 2, 6, 8 and 12 during the day time.

The quantitative distribution of prominent species of plankton are shown in Table 2. The maximum number of adult females of *Oithona nana*, as well as male, was found at the 6 m layer at St. 2, between 4–8 m layers at St. 6, 8 and 12. Copepodid and nauplii of *Oithona nana* were found abundantly at the same layers as in adult forms at each station, although a small number of individuals were found also at the 0–2 m and 9–10 m layers. Both adult and larval forms were hardly found from the lower layers beneath the depth mentioned above. *Sagitta crassa* f. *naikaiensis* and *Oikopleura dioica* appeared only in a small number between 1–6 m layers at Sts. 2, 6 and 12, and 4–8 m layers at St. 8. The polychaete larvae distributed uniformly throughout the stations from surface to the 9–10 m layers, but the size and length of these larvae were larger in the lower layer than in the upper layers. Several individuals of these larvae occurred in more deeper layers where the oxygen content was so small that other animals could not survive there. Tintinnids, such as *Tintinnopsis radix*, *T. cylindrica*, *Helicostomella longa* and *Tintinnus lusus-undae* var. *tenuis* were concentrated in the maximum number at the surface layer, although they distributed downwards to 8–10 m layers. From the data given above it may be concluded that the lower limit of plankton distribution was deeper this time than in the survey of November and that the plankton animals did not inhabit in the deeper 12–12.5 m strata where the dissolved oxygen was quite absent and hydrogen sulphide was produced there. Thus the productive layer of the lagoon seems to be restricted to a thin layer between 0 and 11 meters.

General Consideration and Conclusion

1. The water is highly stagnant, and the salinity in the deeper strata is lower than in the lower strata. The dissolved oxygen content of lower strata is very small or quite absent; thus considerable amount of hydrogen sulphide is produced there almost all the year round. The mud in such area is jet black. These peculiar hydrological conditions have a great influence on the distribution of planktonic organisms; the inhabitable layers are relatively thin.

2. The components of plankton are very few. They are confined to marine organisms which are always found in the innermost part of the inlet waters, euryhaline, eurythermal and at the same time have some ability to tolerate against the changes in other physical and chemical conditions. Nevertheless no brackish water animal was found here. The pelagic fauna is rather monotonous, but the population of each species especially that of *Oithona nana* is very large. The phytoplankton is very small in quantity, and mostly consists of emigrants from Miyazu Bay (YAMAZI, unpublished); namely dinoflagellates comprising *Ceratium tripos*, *C. trichoceros*, *C. furca*, *C. fusus*, *C. lineatum*, *Pyrophacus horologicum* and other 7 neritic dinoflagellates, and diatoms comprising *Ch. peruvianus* and 14 neritic *Chaetoceros*, 6 *Rhizosolenia*, 10 neritic centralis and 7 neritic pennales. *Chaetoceros* (*Ch. affinis*, *Ch. decipiens* and *Ch. laciniosus*) in summer and *Skeletonema costatum* in winter are the most important

phytoplankters.

3. Although the constituent species are almost similar all the year round, their proportions considerably vary from time to time and from station to station. Generally the pelagic community in the lagoon is characterized by the predominance of *Oithona nana* associated with *Acartia*. *A. clausi* is a dominant copepod during spring and *A. spinicauda* is an important member from summer to autumn, although they never exceed *Oithona nana* in number.

Fig. 2. Map of Kumihama Bay, showing the stations.

The larval forms are presumably produced by adult forms living in the lagoon and adapted to the peculiar environment of the lagoon. Polychaete larvae and pelecypod veligers occurred numerously. Neritic copelata *Oikopleura dioica*, chaetognath *Sagitta crassa* f. *naikaiensis* and tintinnids comprising *Tintinnopsis radix*, *Tintinnopsis tenuis*, *Favella campanula*, *Helicostomella longa*, *Tintinnus lusus-undae* var. *tenuis* and *Tin. fraknoii* are all found sparsely. *Dictyocha fibula* occurred remarkably in November, 1946.

4. The distribution of the plankton animals is limited to upper 9–11 m strata, because of the absence of dissolved oxygen and the existence of a considerable amount of hydrogen sulphide in the deeper strata forming the azoic zone. It is notewothy that a large number of abnormally large-sized larvae of benthic polychaetes were found just above this azoic zone far off the shallow coastal region. Probably they had been unable to settle on the bottom and then to grow up, because of unfavourable environment there.

KUMIHAMA BAY

General Hydrological Conditions

Kumihama Bay is about 7 sq. km in area and communicates directly with the Japan Sea through the narrow and very shallow passage, only three meter deep in the north (Fig. 2). The bay is divided into two basins: the main Kumihama basin and Kawati basin. The maximum depth of the bay is 22 meters at St. 9. The mud of the deep parts is soft and jet black in color except in Kawati basin and near the passage, where it was grayish and yellowish brown respectively.

Water temperature at the surface varied from 20.9° to 22.5°C; 21°C was recorded most widely throughout the bay, excepting the region near the passage where it was 22°C (Table 3). Vertically the temperature decreased regularly with depth (Table 4). The salinity at the surface was higher in the mouth than in the inner part of the bay, where the river water of the Sanotani flows in. Vertically salinity increased with depth. Dissolved oxygen decreased conspicuously below 6–9 meter layers to a very small amount or quite near the bottom of the deeper region; and this condition caused the lower limit of the plankton distribution as was found in Yosa-Naikai.

Plankton Community

The Plankton on June 22, 1947

The plankton constituents shown in Table 3 showed a great similarity to that of the Yosa-Naikai. The total number of plankton was larger in the central part and the neighbourhood of the passage, and the population of zooplankton was very rich as in Yosa-Naikai. The larger numbers of zooplankton were recorded at the head and the central part of the Kumihama basin. Copepods and their nauplii and cope-

podids were the most remarkable members in percentage and also in numerical abundance. The total number of copepods was larger in Kawati basin and Sts. 14, 15, 22 and 24 in the Kumihama basin than in the area comprising other stations. *Oithona nana* was predominant in wide range and varied from 0.8 to 16 thousands per 10 liters, from 75 to 90 in percentage composition in total copepods. *Paracalanus parvus* was abundant in Sts. 14, 15, 17, 23 and 24 in Kumihama basin, where it reached up to 16–48 in percentage composition in copepods. The plankton in Kumihama Bay was characterized, this time, by the dominance of *Paracalanus parvus* and diatoms and the fewness of *Acartia* and tintinnids. Ostracods, chaetognath, tunicate and larval forms were also found in the bay as in Yosa-Naikai. Most of the individuals of chaetognath and tunicate were usually in immature stages.

Vertical Distribution of Zooplankton on June 22, 1947

The vertical distribution of plankton at Sts. 9, 16 and 21 in day time is given in Table 4, where the individual numbers in 10 liters of sea water at each layer are compared one another. The total zooplankton attained to the maximum between the 3–9 meter layers except for St. 10 where the maximum was found in the 0–3 meter layers. No plankton was found at all between the 18 meter layer at St. 9 and under the 4 meter layer at St. 21. The vertical distribution of plankton was limited here also by the absence of oxygen together with the existence of hydrogen sulphide in the deeper strata.

Conclusion

1. Kumihama Bay is very like Yosa-Naikai in its isolated topography and in the distribution of water temperature, transparency, water color, salinity, oxygen and pH. The environmental conditions in both bays are by far particular as compared with bays or inlets having a rather wide mouth.

2. The plankton community of the bay is strongly affected by the stagnation caused by the isolation from the open sea as in Yosa-Naikai and Nakanoumi (Miyadi *et al*, 1954). In lower layers of the central part of the bay the oxygen content is extremely small or quite absent and the hydrogen sulphide is produced; therefore the inhabitable layer of the plankton is thinned considerably, although the upper productive stratum is somewhat thicker than in Yosa-Naikai.

3. The lower the salinity and the transparency of the water the more marine species are eliminated in the water, and contrarily the euryhaline and eurythermal species, *Oithona nana* in this case, becomes dominant, being distributed evenly in the bay and associated with *Paracalanus parvus* and *Acartia*. The offshore species brought into the bay from the open sea are too poor as in the case of Yosa-Naikai to contribute to form some characteristic communities. Several individuals of brackish water copepod *Sinocalanus tenellus* occurred in the bay, but only in the innermost

part of lower salinity; on the other hand *Paracalanus parvus* was distributed widely. These two species were not found at all in Yosa-Naikai. Thus it may be concluded safely that Yosa-Naikai is more perfectly stagnant than Kumihama Bay.

4. The constitution of zooplankton is very monotonous as in both Yosa-Naikai and Nakanoumi (MIYADI *et al*, 1954), although some species are produced very abundantly in both waters.

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TABLE 1. Distribution of important zooplankton in Yosa-Naikai. Calculated for 10 liters.

Date	June 4, 1945					Nov. 25, 1945						April 4, 1946				April 20, 1946				Nov. 1, 1946		
Station number	1	6	8	10	14	5	6	7	9	12	14	6	6–8	8	Chan.	2	8	10	12	3	6	12
Transpareney	2	2.5	3.0	2.5	2.0	2.3	2.4	2.5	2.4	2.3	2.0	2.6	2.6	2.6								
Temperature (0 m)	22.0	22.0	22.0	22.0	22.0	14.5	14.2	13.7	13.5	14.5	14.0	16.5	16.5	16.6								
Mud temperature	13.0	13.0	14.0	13.5	16.0	18.5	18.0	18.5	18.3	19.6	20.0	13.4	13.3	13.1								
Total number of zooplankton (Z)																						
Total number of phytoplankton (P)																						
Percentage of Z/Z+P																						
Percentage of P/Z+P																						
Composition of zooplankton																						
Copepods																						
Paracalanus parvus	—	—	—	—	-	—	—	—	-	—	—	-	—	-	-	—	—	—	—	—	—	—
Acartia spinicauda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-	-	-	—	-	-
Acartia clausi	13.6	9.6	12.8	8.9	19.2	13.6	16.0	14.8	13.9	17.2	16.1	1.0	2.1	3.1	2.0	12.8	6.9	17.5	20.0	0.15	0.23	0.04
Oithona nana	69.0	74.7	68.8	63.4	58.0	49.6	67.5	69.8	66.5	75.9	77.5	63,2	60.6	56.6	53.9	68.0	83.8	51.6	21.4	0.21	0.22	0.26
Protozoans																						
Dictyocha fibula	-	—	—	-	—	-	—	-	-	-	—	—	—	—	—	-	—	-	—	95.5	94.9	95.2
Tintinnopsis radix	—	—	—	-	—	—	—	—	—	—	—	3.8	4.2	2.9	3.9	—	-	-	-	1.3	1.1	1.4
Tintinnus tenuis	—	-	—	—	—	-	—	—	—	—	—	—	-		—	—	—	-	—	—	·	·
Tintinnus fraknoii	—	—	—	-	·	—	—	-	-	—	—	0.5	1.2	0.8	1.2	1.7	0.4	9.3	11.1	1.7	1.9	1.4
Helicostomella longa	—	·	·	—	—	—	—	—	—	—	—	—	-	—	—	—	—	—	—	—	-	-
Favella campanula	1.7	—	—	—	—	-	-	—	-	—	—	-	—	-	-	·	-	·	-	—	—	
Other animals																						
Sagitta crassa f. *naikaiensis*	0.3	0.4	0.4	0.6	0.1	2.1	2.4	1.4	1.6	0.8	1.1	0.6	0.7	0.7	0.9	3.7	+	+	1.2	—	—	—
Oikopleura dioica	0.2	—	—	0.3	0.2	-	—	-	—	-	—	0.6	0.6	0.2	0.7	—	·	—	—	—		0.05
Evadne tergestina	2.0	—	-	—	—	—	—	—	—	—	—	0.6	1.0	1.7	—	+	+	1.4	11.4	—	-	+
Podon leuckarti	-	—	—	—	—	—	—	-	-	—			0.6	·	-	—	-	-	—	-	—	·
Penilia schmackeri	—	-	-	·	—	·	·	—	—	—	—	-	—	—	·	—	—	—	—	—	·	-
Larval forms																						
Copepod nauplii	7.6	10.5	5.5	14.9	10.1	19.8	8.1	6.2	9.2	1.7	—	23.8	25.8	27.1	28.6	12.0	7.3	16.9	14.3	0.4	0.4	0.7
Polychaete larvae	3.7	2.1	4.3	3.0	4.2	—	—	—	-	·	—	2.4	1.5	2.9	1.5	2.6	1.4	3.1	14.3	—	—	+
Pelecypod veligers	1.9	1.8	3.1	6.5	4.4	8.0	6.0	5.8	5.8	4.4	5.3	·	·	—	2.9	—			-	·	·	
Gastropod veligers	·	·	3.0	—	—	6.5	·	2.0	3.0	—	—	1.9	-	1.5	1.2	—	·	—	—	—	—	·

TABLE 1. (Continued)

Date	June 20, 1947																					
Station number	2		3		4		5		6		7		8		9		10		11		12	
Transpareney	3.3		3.7		3.7		3.6		3.6		3.0		4.0		3.4		2.7		2.5		2.8	
Temperature (0 m)	23.0		23.0		22.9		23.0		23.0		23.9		22.9		23.0		24.0		24.6		24.9	
Mud temperature	15.5		15.5		15.8		—		15.1		16.0		—		15.4		15.5		16.0		17.8	
Total number of zooplankton (Z)																						
Total number of phytoplankton (P)																						
Percentage of Z/Z+P																						
Percentage of P/Z+P																						
Composition of zooplankton																						
Copepods																						
Paracalanus parvus	—	-	—	—	—	—	—	—	—	—	—	-	-	—	—	—	—	—	—	-	—	-
Acartia spinicauda	—	—	—	—	-	—	-	—	—	—	—	—	—	—	—	-	-	—	—	—	-	—
Acartia clausi	—	-	—	—	—	—	—	—	—	—	30	0.1	—	—	—	—	—	—	—	—	—	—
Oithona nana	180	12	630	6.5	2,750	37.1	2,410	24.1	690	50.0	10,350	38.3	1,830	22.2	3,070	25.0	7,280	36.0	8,260	91.4	1,080	33.8
Protozoans																						
Dictyocha fibula	-	—	—	—	—	—	—	—	—	—	—	-	—	—	-	-	—	—	-	—	—	—
Tintinnopsis radix	—	—	—	—	—	-	—	—	-	—	—	—	—	—	—	—	—	—	—	—	—	—
Tintinnus tenuis	—	—	—	—	—	—	-	—	-	—	-	-	—	—	—	-	—	—	—	—	-	—
Tintinus fraknoii	-	—	-	—	—	—	·	—	—	—	—	—	—	—	—	—	—	—	—	—	-	-
Helicostomella longa	—	—	—	-	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Favella campanula	—	—	—	—	—	-	-	-	—	—	—	—	-	-	—	—	—	—	—	—	—	—
Other animals																						
S. crassa f. *naikaiensis*	+	+	-	-	—	—	—	—	+	+	—	—	+	+	-	-	-	—	—	—	—	+
Oikopleura dioica	+	0.6	+	0.1	-	—	—	—	-	—	+	0.1	+	0.1	-	-	-	—	+	0.1	-	—
Evadne tergestina	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Podon leuckarti	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
Penilia schmackeri	—	-	—	—	—	—	—	-	—	—	—	—	-	—	—	—	-	-	—	—	—	-
Larval forms																						
Copepod nauplii	1,200	80	8,860	91.5	4,640	62.4	7,560	75.6	720	53.7	15,310	57.9	6,240	75.8	9,140	74.8	13,820	61.9	640	7.0	1,860	61.0
Polychaete larvae	20	1.3	30	0.3	30	0.4	20	0.2	—	—	40	0.2	50	0.6	40	0.3	40	1.8	70	0.8	30	1.0
Pelecypod veligers	—	—	-	—	10	0.1	20	0.2	—	—	30	0.1	20	0.2	—	-	—	—	10	0.1	—	—
Gastropod veligers	—	—	—	—	—	—	-	—	-	—	-	—	—	—	—	—	—	-	-	—	-	—

TABLE 1. (Continued)

Date	June 20, 1947										March 19, 1948													
Station number	13		14		15		16		Chan.		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Transpareney	2.5		2.4		2.5		2.5		—		4.6	4.8	4.9	4.7	5.0	5.0	4.0	4.8	4.6	3.7	3.7	3.6	3.8	3.8
Temperature (0 m)	24.4		24.5		24.8		23.4		—		11.5	10.8	10.6	9.0	10.0	9.2	8.9	9.0	9.0	8.5	8.0	7.5	7.5	7.3
Mud temperature	19.9		19.5		—		—		—		12.5	11.5	11.3	11.3	11.2	11.0	11.0	11.0	11.0	11.8	12.0	12.2	12.0	12.0
Total number of zooplankton (Z)																								
Total number of phytoplankton (P)																								
Percentage of Z/Z+P																								
Percentage of P/Z+P																								
Composition of zooplankton																								
Copepods																								
Paracalanus parvus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Acartia spinicauda	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.9	10.8	4.4	2.7	3.7	—	—	—	—
Acartia clausi	—	—	—	—	—	—	—	—	—	—	3.5	10.8	3.8	1.2	3.4	3.7	6.7	8.6	3.5	1.5	8.7	11.6	16.4	4.1
Oithona nana	10,000	36.1	2,130	7.3	4,180	27.6	1,960	34.9	490	57.2	31.6	11.3	16.4	7.9	6.2	6.7	9.8	12.9	11.1	2.7	—	—	22.8	24.2
Protozoans																								
Dictyocha fibula	—	—	—	—	—	-	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tintinnopsis radix	—	—	—	—	—	—	—	—	-	—	0.9	11.3	7.4	8.3	18.1	19.6	14.0	28.9	46.0	80.6	25.6	34.1	8.8	8.1
Tintinnus tenuis	—	-	—	—	—	—	—	—	—	-	1.7	1.6	—	1.2	5.1	—	3.8	2.9	3.1	0.9	-	-	3.9	4.0
Tintinnus fraknoii	—	—	—	—	—	-	—	—	—	—	28.1	19.5	16.0	65.0	21.4	6.7	10.5	9.4	10.7	1.6	18.8	-	—	9.5
Helicostomella longa	-	—	—	—	—	—	—	—	-	—	1.8	2.7	4.2	4.7	8.5	3.7	16.7	13.8	14.6	5.2	20.2	27.0	22.6	31.5
Favella campanula	—	—	—	—	—	-	—	—	—	-	—	—	—	—	—	—	—	—	—	-	—	—	—	—
Other animals																								
S. crassa f. *naikaiensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oikopleura dioica	—	—	—	—	—	—	—	—	+	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Evadne tergestina	—	—	—	-	—	—	—	-	—	-	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Podon leuckarti	-	—	—	—	—	-	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Penilia schmackeri	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Larval forms																								
Copepod nauplii	17,620	63.6	2,630	92.4	10,690	72.0	4,780	83.7	260	30.9	29.9	19.5	28.0	4.4	15.8	16.8	12.9	22.0	7.2	3.7	17.6	9.2	11.3	8.5
Polychaete larvae	60	0.2	50	0.1	20	0.1	20	0.3	20	2.0	2.6	11.3	16.2	—	21.5	19.5	14.6	—	-	2.7	8.9	18.3	10.7	—
Pelecypod veligers	—	—	-	—	-	—	—	—	—	-	-	—	—	—	—	—	—	—	—	—	—	—	—	—
Gastropod veligers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14.7	—	-	-	0.2	—	-	3.8	2.0

TABLE 2. Vertical distribution of hydrological conditions and zooplankton components in Yosa-Naikai. Calculated for 10 liters.

Date	November 1, 1946																
Station number	3									6							
Depth (m)	0	1	2	3	4	5	6	7	9	0	2	3	5	6	9	10	12
Temperature (°C)																	
Salinity (‰)																	
Oxygen (cc/L)																	
Oxygen (%)																	
Total number of zooplankton	53,980	47,900	13,960	8,520	4,630	5,210	6,630	1,150	0	13,180	17,850	11,940	32,520	8,220	3,150	940	—
Total number of phytoplankton	485,820	51,320	600,870	225,230	150,000	87,900	41,500	50,200	+	121,780	157,650	99,570	391,880	52,830	36,680	8,800	+
Percentage of Z/Z+P																	
Percentage of P/Z+P																	
Composition of zooplankton																	
Copepods																	
Paracalanus parvus	-	-	—	-	—	—	—	-	—	-	—	-	—	-	-	-	—
Acartia clausi	80	40	30	20	50	20	—	—	—	30	10	10	50	—	10	—	—
Oithona nana ♂	110	120	160	80	70	320	190	20	—	30	90	70	300	30	20	10	—
Oithona nana ♀																	
Protozoans																	
Dictyocha fibula	51,500	46,550	12,100	7,750	1,720	2,600	4,200	1,000	—	12,500	16,550	6,380	29,350	7,500	2,800	750	-
Tintinnopsis radix	720	450	620	200	230	250	120	50	—	150	300	520	200	50	0	0	-
Tintinnus tenuis	900	200	470	170	150	180	—	—	—	250	500	600	390	100	120	0	—
Tintinnus fraknoii	—	—	-	—	—	-	-	—	—	—	—	-	—	—	-	-	—
Helicostomella longa	—	—	-	-	—	—	-	—	—	—	-	-	—	—	-	-	—
Favella campanula	50	100	120	30	70	80	—	—	-	—	-	200	150	60	-	—	—
Other animals																	
S. crassa f. *naikaiensis*	-	—	—	—	-	-	10	—	—	—	-	—	10	-	10	—	-
Oikopleura dioica	-	—	10	—	—	—	—	—	—	—	—	—	—	-	-	—	-
Evadne tergestina	-	—	—	—	-	—	—	—	—	—	10	—	10	-	-	—	-
Podon leuckarti	-	10	—	-	-	-	—	-	—	-	—	—	-	-	-	—	-
Penilia schmackeri	—	—	—	—	-	-	—	-	—	—	20	10	20	-	10	-	—
Larval forms																	
Copepod nauplii and copepodids	230	280	410	130	120	170	70	—	-	50	80	130	370	30	20	20	—
Polychaete larvae	—		—	—	-	10	-	80	—	-	—	-	—	80	40	30	—
Pelecypod veligers	—		—	-	-	—	-	—	-	—	10	-	10	—	-	-	—
Gastropod veligers	—	-	—	-	-	—	—	-	—	—	—	-	—	—	—	-	—

TABLE 2. (Continued)

Date	November 1, 1946						June 20, 1947									
Station number	12						2						6			
Depth (m)	0	1	3	6	10	11	0	2	4	6	10	12	0	2	4	6
Temperature (°C)							23.0		21.86	20.85	17.82	16.76	23.00	22.73	21.23	20.55
Salinity (‰)							22.99			26.91	30.70	29.90	22.79	24.33	28.71	29.00
Oxygen (cc/L)							5.87			4.86	3.19	1.69	6.09	5.93	5.38	2.91
Oxygen (%)							108.1			87.5	55.4	28.4	112.1	108.3	98.5	53.6
Total number of zooplankton	44,110	53,720	45,060	42,010	5,380	-	440	6,470	2,2170	24,000	280	—	670	2,820	13,640	12,720
Total number of phytoplankton	551,040	37,860	30,000	262,750	60,000	5,000	400	290	300	330	90	—	120	90	30	70
Percentage of Z/Z+P																
Percentage of P/Z+P																
Composition of zooplankton																
Copepods																
Paracalanus parvus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Acartia clausi	20	30	40	10	—	—	—	—	10	—	—	—	—	—	—	—
Oithona nana ♂	—	—	—	—	—	—	10	30	90	80	10	—	—	40	90	30
Oithona nana ♀	110	80	90	30	20	-	50	350	960	2,790	150	—	210	1,270	227	1,860
Protozoans																
Dictyocha fibula	42,000	47,500	30,600	30,282	4,710	—	—	—	—	—	—	—	—	—	—	—
Tintinnopsis radix	600	210	600	250	—	—	60	10	—	—	—	—	30	10	80	70
Tintinnus tenuis	600	1,500	400	300	—	—	20	10	—	—	—	—	—	—	10	—
Tintinnus fraknoii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Helicostomella longa	—	—	—	—	—	—	240	160	50	50	—	—	80	130	440	50
Favella campanula	—	400	100	300	—	—	—	—	—	—	—	—	—	—	—	-
Other animals																
S. crassa f. *naikaiensis*	—	—	—	—	—	—	10	20	—	—	—	—	—	10	10	—
Oikopleura dioica	20	—	—	—	—	—	10	10	10	—	—	—	—	20	10	—
Evadne tergestina	10	10	—	—	10	—	-	—	—	—	—	—	—	-	—	-
Podon leuckarti	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Penilia schmackeri	10	30	40	—	10	—	—	—	—	—	—	—	—	—	20	-
Larval formsl																
Copepod nauplii and copepodids	270	210	380	80	30	—	300	5,060	2,046	20,040	40	—	140	1,070	9,440	9,410
							100	650	460	940	20	—	100	140	1,080	1,240
Polychaete larvae	—	—	—	30	40	—	10	20	10	30	40	10	—	40	90	40
Pelecypod veliger	—	10	10	10	10	—	—	10	10	—	—	—	—	—	—	—
Gastropod veliger	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 2. (Continued)

Date	June 20, 1947															
Station number	6			8							12					
Depth (m)	8	10	12	0	2	4	6	8	10	12.5	0	2	4	6	8	9
Temperature (°C)	20.55	17.58	16.93	22.90	22.19	21.76	20.66	20.63	19.18	17.73	24.90			20.60		17.23
Salinity (‰)	29.72	30.19	30.10	22.36	24.76	27.61	28.61	29.31	30.01	29.49	21.32			28.42		29.65
Oxygen (cc L)	2.46	1.67	1.67	5.82	5.87	5.82	5.59	4.86	3.19	1.23	6.09			5.71		2.85
Oxygen (%)	45.0	28.3	28.3	106.9	106.5	104.4	100.9	88.3	57.6	20.6	103.5			103.0		48.5
Total number of zooplankton	10,240	—	—	460	1,960	6,890	12,320	8,180	1,140	40	1,160	5,710	17,860	13,530	14,540	7,050
Total number of phytoplankton	20	—	—	170	130	120	140	90	30	0	240	290	300	270	120	110
Percentage of Z/Z+P																
Percentage of P/Z+P																
Composition of zooplankton																
Copepods																
Paracalanus parvus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Acartia clausi	—	—	—	—	—	—	—	—	—	—	10	10	—	10	10	—
Oithona nana ♂	60	—	—	0	40	60	50	80	—	—	20	40	70	50	100	50
Oithona nana ♀	3,950	—	—	100	770	1,060	210	2,180	550	—	340	1,530	340	283	7,640	2,220
Protozoans																
Dictyocha fibula	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tintinnopsis radix	—	—	—	—	20	10	20	20	—	—	10	20	10	20	10	10
Tintinnus tenuis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tintinnus fraknoii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Helicostomella longa	30	—	—	30	50	40	50	40	20	—	20	120	20	30	10	20
Favella campanula	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other animals																
S. crassa f. *naikaiensis*	—	—	—	—	—	—	10	10	—	—	—	—	—	—	—	—
Oikopleura dioica	—	—	—	—	—	10	20	10	—	—	—	30	—	—	—	—
Evadne tergestina	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Podon leuckarti	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Penilia schmackeri	10	—	—	—	—	10	40	10	—	—	—	—	—	—	—	—
Larval forms																
Copepod nauplii and copepodids	4,940	—	—	50	700	5,080	9,830	4,930	430	—	400	2,270	12,490	8,970	3,920	3,780
	1,190	—	—	160	280	490	980	350	80	—	240	1,270	1,590	1,370	2,730	920
Polychaete larvae	20	—	—	50	40	30	30	10	20	40	10	220	40	60	40	30
Pelecypod veligers	10	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
Gastropod veligers	30	—	—	—	—	—	—	—	—	—	—	40	20	10	—	—

TABLE 3. Distribution of zooplankton in Kumihama Bay on June 22, 1947. Calculated for 10 liters.

Station number	2	3	5	6	7	9	10	12	13	14
Depth (m)	6.5	3.2	3.0	12.5	21.0	22.0	15.0	9.0	12.5	11.4
Transparency (m)	4.9	+	+	4.5	4.2	4.8	5.0	4.5	4.4	4.1
Temperature at 0 m (°C)	22.0	21.9	21.0	21.0	20.8	22.2	22.9	21.0	20.9	21.4
Bottom texture	M	S	S	M	M	M	M	M	M	M
Total number of zooplankton (Z)	46,150	4,720	21,960	18,430	7,680	14,080	16,450	17,880	19,040	29,740
Total number of phytoplankton (P)	17,140	8,750	22,870	8,080	12,730	12,400	17,510	40,460	33,710	16,260
Percentage of Z/Z+P	72.9	36.2	48.9	69.5	37.6	63.2	48.4	30.6	36.9	64.6
Percentage of P/Z+P	27.1	63.8	51.1	30.5	62.4	36.8	51.6	69.4	64.0	35.4
Composition of zooplankton										
Copepods										
Paracalanus parvus	820	200	810	840	320	670	420	560	420	1,200
Acartia clausi	—	—	—	—	—	—	—	—	—	—
Oithona nana	7,680	750	2,020	2,640	1,370	2,020	3,390	3,200	3,120	6,020
Protozoans										
Distephanus speculum	40	20	30	10	10	30	—	20	—	—
Tintinnopsis sufflata	40	30	40	40	30	30	80	1,530	120	—
Tintinnopsis radix	20	10	20	30	10	20	20	400	70	280
Tintinnus tenuis	10	10	10	—	—	—	10	—	—	—
Helicostomella longa	80	30	120	50	40	40	60	80	60	70
Other animals										
S. crassa f. *naikaiensis*	40	10	+	+	20	40	180	100	40	20
Oikopleura dioica	50	40	60	20	40	—	100	20	80	40
Evadne tergestina	20	20	30	10	40	10	20	60	40	90
Penilia schmackeri	20	10	10	10	—	—	—	—	20	10
Podon leuckarti	30	10	50	20	10	+	20	60	20	—
Larval forms										
Oithona nana nauplii	36,480	3,050	17,660	12,720	5,020	10,410	11,620	12,250	14,250	21,440
Paracalanus nauplii	470	380	510	440	270	330	380	230	280	400
Polychaete larvae	30	10	20	30	120	20	10	10	20	20
Pelecypod veligers	70	+	20	40	50	20	10	10	30	10
Gastropod veligers	130	50	310	70	70	70	50	20	30	20

TABLE 3. (Continued)

Station number	15	16	17	19	20	21	22	23	24	Total
Depth (m)	10.0	15.0	12.9	13.0	14.0	6.0	4.3	5.0	3.0	
Transparency (m)	4.3	4.4	4.1	4.3	4.3	3.5	3.3	3.8	2.9	
Temperature at 0 m (°C)	21.1	21.9	21.0	21.0	21.2	22.5	21.2	21.0	21.0	
Bottom texture	M	M	M	M	M	M	M	M	M	
Total number of zooplankton (Z)	42,710	7,340	9,390	8,970	8,100	7,680	8,280	47,590	4,720	423,240
Total number of phytoplankton (P)	32,670	16,970	9,440	9,160	11,330	18,210	2,662	44,070	63,880	879,560
Percentage of Z/Z+P	56.6	30.2	49.8	49.4	41.7	29.6	75.6	50.2	7.1	51.9
Percentage of P/Z+P	43.4	69.8	50.2	50.6	58.3	70.4	24.4	49.8	92.9	48.1
Composition of zooplankton										
Copepods										
Paracalanus parvus	1,680	230	960	320	150	80	600	920	980	1,290
Acartia clausi	—	—	—	—	—	—	90	40	30	160
Oithona nana	9,160	680	1,050	2,210	1,280	270	16,250	4,260	2,820	71,460
Protozoans										
Distephanus speculum	—	—	—	—	—	—	—	—	—	160
Tintinnopsis sufflata	20	10	30	10	30	—	60	80	90	2,260
Tintinnopsis. radix	180	30	40	50	50	70	330	250	2,940	4,820
Tintinnus tenuis	—	—	—	—	—	—	—	—	—	40
Helicostomella longa	30	40	—	—	—	30	140	180	—	1,050
Other animals										
S. crassa f. *naikaiensis*	30	+	+	10	20	+	20	10	+	560
Oikopleura dioica	30	10	—	20	40	50	60	40	60	700
Evadne tergestina	20	40	20	10	40	+	10	—	+	450
Penilia schmackeri	10	10	—	10	10	10	20	20	—	160
Podon leuckarti	—	—	—	—	—	10	—	10	—	240
Larval forms										
Oithona nana nauplii	30,550	6,010	6,210	6,010	6,080	6,820	61,880	40 530	38,670	348,620
Paracalanus nauplii	670	190	1,000	130	200	280	3,170	880	1,610	12,030
Polychaete larve	20	10	100	40	20	—	40	30	—	550
Pelecypod veliger	30	40	10	30	10	—	40	50	—	450
Gastropod veliger	40	+	20	30	100	—	20	20	—	1,040

TABLE 4. Vertical distribution of hydrological conditions and zooplankton components in Kumihama Bay on June 22, 1947. Calculated for 10 liters.

Station number	9								16						21			
Depth (m)	0	3	6	9	12	15	18	21	0	3	6	9	12	14	0	3	4	5.5
Temperature (°C)	21.9	21.21	18.55	18.74	18.37	18.49	18.30		21.90	21.76	17.75	18.11	18.18	18.15	22.50	22.45	19.42	18.00
Salinity (‰)	20.33	28.13	30.25	30.73	31.20	34.43	34.72		—	32.77	33.53	34.13	34.23	34.43	22.56	29.19	32.61	32.74
Oxygen (cc/L)	6.03	5.44	3.17	3.15	2.44	1.14	2.67		6.08	5.32	2.17	2.15	1.78	1.88	6.27	6.09	2.28	1.71
Oxygen (%)	110.5	99.0	55.8	53.5	37.6	20.6	48.2		-	100.7	38.7	38.5	32.1	33.8	112.7	112.6	41.1	32.6
Total number of zoo-	16,350	8,330	6,610	5,780	1,860	650	—	—	741	2,972	3,186	3,576	148	97	756	2,306	—	—
Total number of phyto-	17,510	16,240	9,670	4,280	570	370		—	1,697	1,327	348	170	77	0	1,821	1,088	—	-
Percentage of Z/Z+P	48.2	33.9	40.6	57.4	76.5	63.7	—	—	30.4	69.2	90.1	95.4	65.7	100	41.5	67.9	-	—
Percentage of P/Z+P																		
Composition of zoo-																		
Copepods																		
Paracalanus parvus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Acartia clausi	420	160	120	70	60	20	—	—	230	420	420	560	70	—	80	100	—	—
Oithona nana	3,390	1,240	1,170	1,960	480	120	—	—	680	3,570	3,620	2,940	530	280	280	2,610	—	—
Protozoans																		
Distephanus speculum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tintinnopsis sufflata	80	—	20	20	—	—	—	—	30	70	50	20	10	—	70	20	—	—
Tintinnopsis radix	20	10	10	80	19	—	—	—	10	40	60	30	10		—	—	—	—
Tintinnus tenuis	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Helicostomella longa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other amimals																		
S. crassa f. *naikai-ensis*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oikopleura dioica	100	20	—	—	—	—	—	—	10	20	—	20	—	—	10	20	—	—
Evadne tergestine	—	60	10	10	—	—	—	—	20	10	40	—	—	—	—	80	—	—
Penilia schmackeri	+	40	40	10	—	—	—	—	—	10	10	—	—	—	—	—	—	-
Podon leuckarti	20	10	—	—	—	—	—	—	—	—	20	—	—	—	—	—	—	—
Larval forms																		
Oithona nauplii	6,550	3,720	3,100	1,580	840	70		—	5,320	20,350	21,400	27,600	220	350	5,600	17,120	—	—
Oithona copepodids	5,070	2,510	1,630	1,800	290	150	—	—	690	4,520	5,380	3,520	80	260	1,220	2,730	-	—
Paracalanus nauplii	110	120	100	20	20	—	—	—	80	180	210	220	40	—	60	70	—	—
P. copepodids	120	140	80	30	10	—	—	—	110	290	290	300	20	—	230	160	—	—
Polychaete larvae	10	40	30	+	10	40	—		10	40	40	20	60	40	—	20	—	—
Pelecypod veligers	10	+	+	10	10	20	—	—	40	+	+	20		—	—	—	—	—
Gastropod veligers	50	10	30	10	40	160	—	—	20	+	+	40	410	—	—	40	—	—

DESCRIPTIONS ON THE AGGREGATED FORM OF *BROOKSIA ROSTRATA* (TRAUSTEDT), AN INSUFFICIENTLY KNOWN SALPA[1)]

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With Plates IX–X and 4 Text-figures

Salpa rostrata Apstein, C. (1894): Die Thaliacea der Plankton-Expedition. B. Verteilung der Salpen. Ergebn. Plankton-Exped., Bd. 2, E a, pp. 16–19, Pl. II figs. 17–22, Text-fig. IX.
Brooksia rostrata Metcalf, M. M. (1918): The Salpidae: a taxonomic study. U. S. Nat. Mus. Bull. 100, Vol. 2, Part 2, p. 52, Fig. 24.
Ihle, J. E. W. (1935): Desmomyaria in Kükenthal & Krumbach Handb. d. Zool., Bd. 5, Hälf. 2, Lief. 5, p. 476.
Ihle, J. E. W. (1939): Salpidae in Bronns Kl. u. Ord. Tierreichs, Bd. 3, Suppl. Tunikaten, Abt. II 2, Lief. 3, pp. 188 & 222, Fig. 167.
Thompson, H. (1948): Pelagic tunicates of Australia. Melbourne, pp. 121–123, Pl. 43 figs. 2 & 3, Text-fig. 13.
Yount, J. L. (1954): The taxonomy of the Salpidae (Tunicata) of the central Pacific Ocean. Pacific Science, Voll. VIII, No. 3, pp. 293–295, Fig. 9a.

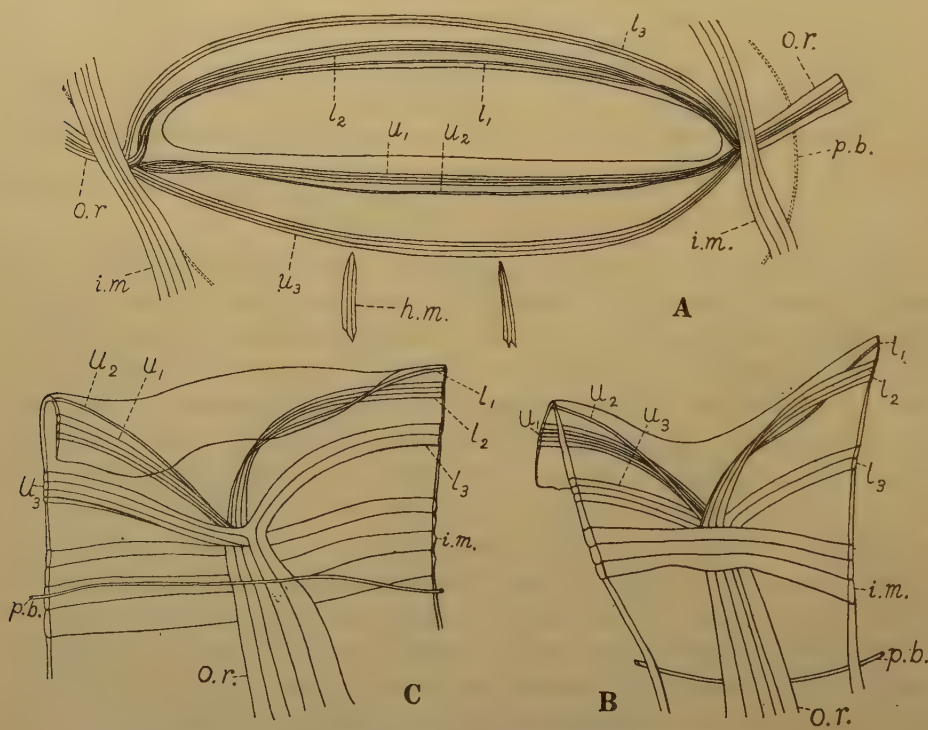
Eleven individuals were found in plankton samples collected by members of the former Fisheries Experimental Station of the South Sea Islands in the neighbouring waters of the Palao Islands in 1940. They were 0.8 mm—2 mm in body length and more or less mutilated excepting a few individuals nearly in a perfect condition. Test is so delicate that it is almost lost in these preserved specimens. Body roughly oval in outline (Pl. IX) and has a stout anterior attachment process (at. $pr._1$) of a considerable length on the left side in the sinistral individual and on the right in the dextral one, and two processes on the right side in the sinistral individual and on the left in the dextral one. Of the two processes, the middle attachment process (at. $pr._2$) is small and situated at the side of the oral aperture, while the posterior process (at. $pr._3$) is larger than the middle one and situated slightly posterior to the middle of the body. Oral aperture dorsal; atrial aperture dorsal in the sinistral individual, but terminal or subterminal in the dextral individual. Nucleus compact and situated at the posterior end in the sinistral individual, while slightly in front of the rear end of the body in the dextral individual. A long protuberance is protruded posteriorly

1) Contributions from the Seto Marine Biological Laboratory, No. 246.

from the rear end of the nucleus and contains the testis in its distal swelling. This protuberance, the testicular process, may be slightly longer than a half of the body length when it is long.

Musculature

Oral muscles (Text-fig. 1): Both upper and lower lips are provided each with three sphincters, all complete and gathered to a short but stout retractor at each side of the mouth. u_2 and l_1 are very thin. Muscle fibres of l_3 and l_2 and one of u_3 are continuous to fibres of retractors, while others join to the retractor at the angle. Intermediate muscles (i. m.) of both sides touch each other at the anterior attachment process; dorsally the left intermediate muscle fuses with the first body muscle (I) and the right one joins to I in the sinistral individual, while the left muscle joins to I and the right one fuses with I in the dextral individual. Horizontal muscles are short and do not reach to u_3. Numbers of fibres of these oral muscles are as follows:



Text-fig. 1. *Brooksia rostrata* (TRAUSTEDT), aggregated form.
Oral musculature, enlarged. A—Entire musculature, B—Right angle, from outside; C—Left angle, from inside.
h. m. ··· Horizontal muscle, i. m. ... Intermediate muscle, o. r....Oral retractor, p. b. ... Peripharyngeal band, 1_1-1_3 ... First to third sphincters of lower lip, u_1-u_3 ... First to third sphincters of upper lip.

u_1 3–5	l_3 2
u_2 1	retractors 5
u_3 3–4	intermediate muscles ..... 3–4 (dorsal)
l_1 1	..... 4–5 (ventral)
l_2 3	horizontal muscles 3

Body muscles (Plate IX): Apstein (1894) gave, in the dextral zooid, 4 muscles on the right and 3 ones on the left side. This statement differs from the actual feature observed in fully grown individuals. Thompson (1948) does not describe clearly about the number of body muscles, although his figure (Pl. 43, fig. 2) shows strictly the outline of these muscles. Yount (1954) correctly gives 4 muscles on one side and 5 ones on the other side. The arrangement of body muscles is, however, not yet described fully, so I wish to give below some details of the arrangement taking up the sinistral individual (Pl. IX, figs. A & B) as an example. The arrangement in the dextral individual (Pl. IX, figs. C & D) may be easily understood as a mirror image of that in the sinistral individual.

On the dorsal side: i. m., I and II on the left side are united into a broad muscle band running obliquely towards the right posterior where it is divided into III, IV and another muscle which is then divided into V and first atrial sphincter (X). I and II on the right side are also united into a band running obliquely beneath the band, compound of i. m., I and II, towards the left posterior where it is divided into III, IV and X. Numbers of fibres of body muscles and X are as follows:

I 3	i. m. +I (left) ... 6–7
II 3	i. m. +I+II (left)→III+IV+V+X (right) ... 10
III 3	III+IV (right) ... 6–7
IV ..... 3 (left), 4 (right)	V+X (right) ... 6
V 3	I+II (right)→III+IV+X (left)... 6–10
X 3	IV+X (right)... 6

IV on the right side ends in the posterior attachment process, while it goes on ventrally on the other side. The right X proceeds far into the posterior protuberance to the testis, while the left one goes round the corner of the atrial aperture and reaches near the anus.

On the ventral side: There is a strong muscle band (ob. m.) running obliquely from the anterior attachment process to the posterior one. I–IV on the left side are all continued to that oblique muscle, II and III are fused with each other before they reach ob. m. I on the right side appears on the ventral side round the posterior side of the middle attachment process and joins to ob. m. at the point just opposite the place where II+III on the left side reaches ob. m. III on the right side also joins to ob. m. at the point opposite the place where IV on the left side reaches ob. m.; from this joining point another short oblique muscle, demi-oblique- muscle (d. ob. m.), starts for the middle attachment process and runs across I along the outer side. Right II ends freely near d. ob. m., V enters the space between ob. m. and IV at the posterior attachment

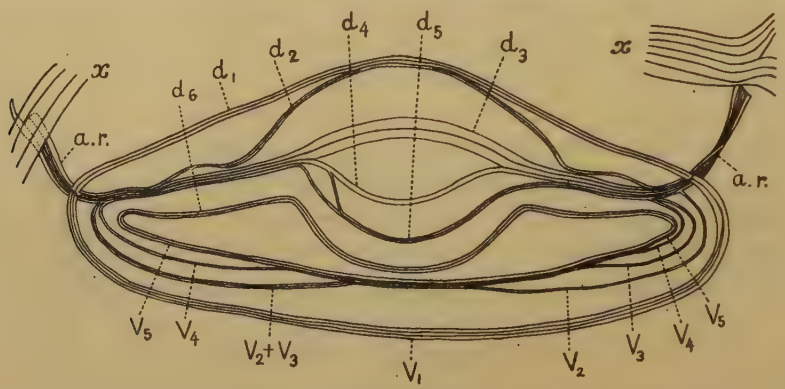
process and touches both muscles. Numbers of muscle fibres are:

ob. m. ..... 4 (anterior) → 9–10 (middle) → 3 (posterior)

d. ob. m. 3

It is a noticeable phenomenon that IV on the left side increases in number of fibres, up to 6, before the muscle reaches ob. m. (Pl. IX, fig. E).

Atrial muscles (Text-fig. 2): Besides the thick first atrial sphincter (X), there are many thinner sphincters on atrial lips, six on the dorsal and five on the ventral lip. d_6 continues to v_5 on the ventral lip and independent of the atrial retractor. d_1 and d_2 are touching medially each other, d_3, d_4 and d_5 are united at each side into a thick band in a considerable length and only d_6 is quite free. Of these sphincters d_3 is very remarkable in its broadness. v_2–v_5 are united medially into a band, the free parts of these muscles being diminished distally; v_1 is free. Fibres



Text-fig. 2. *Brooksia rostrata* (TRAUSTEDT), aggregated form. Atrial musculature, enlarged. a. r. ... Atrial retractor, d_1–d_6 ... Second to seventh sphincters of dorsal lip, v_1–v_5 ... First to fifth sphincters of ventral lip, x ··· First atrial sphincter.

of d_2–d_5 and v_2–v_4 are continued to those of the atrial retractor; d_1 and v_1 join to the retractor, but are not fused with it. The left retractor reaches beneath X, while the right one attains near X. Numbers of fibres of atrial sphincters are as follows:

d_1 2
d_2 ..... 1–2 } d_1+d_2 3

d_3 2
d_4 1
d_5 ..... 2 } d_3-d_5 5

d_6 1

v_1 3

v_2 1
v_3 1
v_4 1
v_5 ..... 1 } v_2-v_5 3

retractors 7

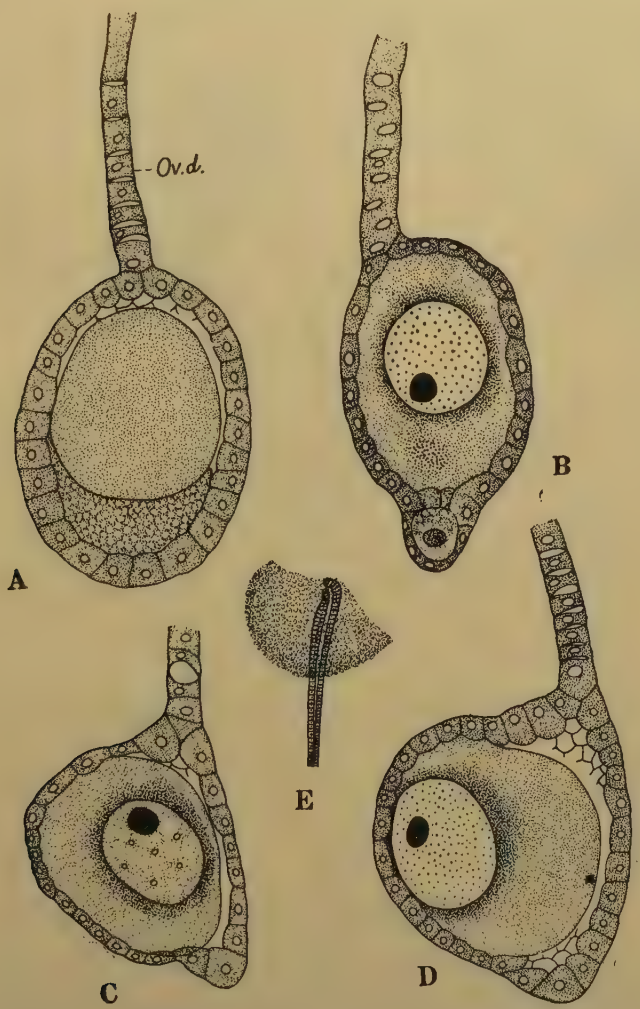
Alimentary Organs

The endostyle is short, the anterior end is strongly curved dorsads and the posterior end is situated near the joining point of I to ob. m. The nucleus seems

to be in "der Zustand E". The right blind sac is roundish in outline, while the left one is elongate in shape and larger than the right sac. Generally some remains of the eleoblast are found at the rear side of the nucleus (Pl. X, figs. A–E).

Reproductive Organs

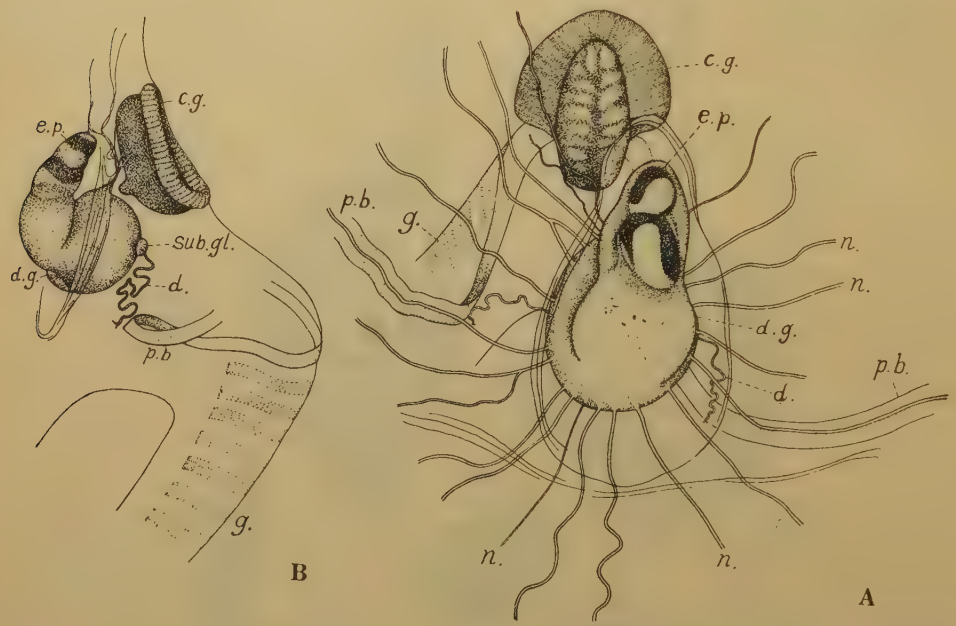
Testis (Pl. X, figs. F–I): Fully matured testis consists of 5 lobules, each slender and simple cylindrical in outline. In younger individuals, the testicular process is



Text-fig. 3. *Brooksia rostrata* (TRAUSTEDT), aggregated form. A—Ovary containing a fertilized egg, B—Ovary containing a small excess ovum, C & D—Ovary containing an unfertilized egg, E—Opening of oviduct, all ×630.
ov. d. ... Oviduct.

very short and the testis consists of merely a single mass; the process and the testicular lobules seem to grow or increase in number with age. Vas deferens opens near the anus.

Ovary (Text-fig. 3): At first the ovary is situated between the atrial aperture and the nucleus (× in Pl. X, fig. A), but carried forwards in the development near III in the dextral individual and V+X in the sinistral one. Usually an egg is found in the ovary, although another small excess ovum may be observed in rare cases (Fig. B). Embryo always single.



Text-fig. 4. *Brooksia rostrata* (TRAUSTEDT), aggregated form.
A—Ciliated groove and dorsal ganglion, dorsal; ×200. B—The same portions from the right side, ×110.
c. g. ... Ciliated groove, d. ... Duct of subneural gland, d. g. ... Dorsal ganglion, e. p. ... Eye-pigment, g. ... Gill, n. ... Nerve, p. b. ... Peripharyngeal band, sub. gl. ... Subneural gland.

Sensory Organs

The proper part of the ciliated groove is elongate in shape and fringed with rather wide border. It is situated obliquely at the antero-ventral side of the dorsal ganglion and issues a minute prominence towards the ganglion. The eye-pigment consists of two ∩-shaped parts. The subneural gland small, a pair of ducts from the gland meandering in their ways and open each to the pharynx near the peripharyngeal band (Text-fig. 4).

EXPLANATION OF PLATES IX-X

Plate IX

Brooksia rostrata (Traustedt), aggregated form; test removed.

A...Dorsal side of a 2 mm long sinistral individual.
B...Ventral side of the same individual.
C...Dorsal side of a 1.8 mm long dextral individual.
D...Ventral side of the same individual.
E...Increasing point of muscle fibres in IV, enlarged.

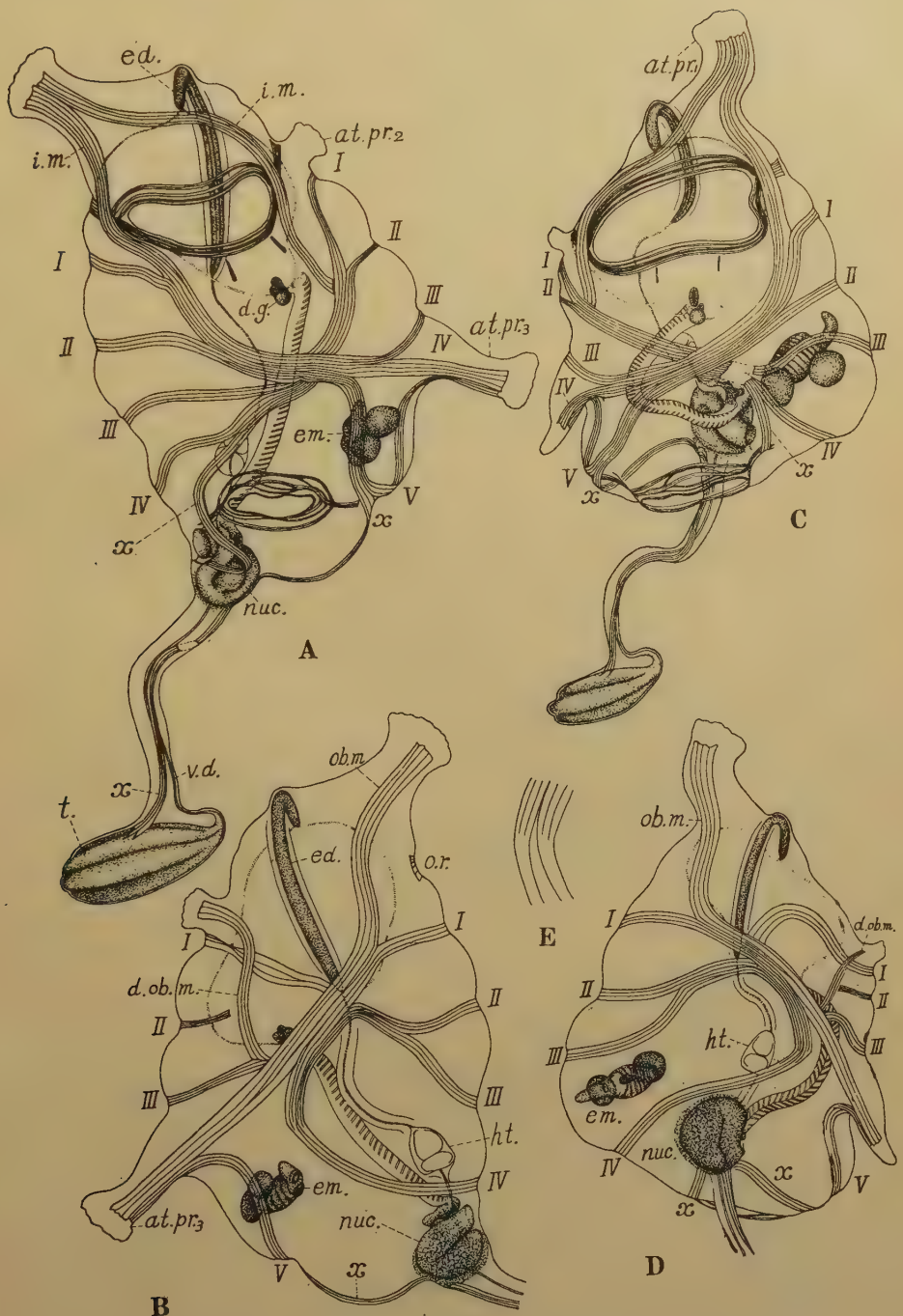
at. pr.$_1$.....Anterior attachment process
at. pr.$_2$.....Middle attachment process
at. pr.$_3$.....Posterior attachment process
d. g. .....Dorsal ganglion
d. ob. m. ...Demi-oblique-muscle
ed. .....Endostyle
em. .....Embryo
ht.....Heart
i. m. .....Intermediate muscle
nuc. .....Nucleus
ob. m. ...Oblique muscle
o. r. .....Oral retractor
t. .....Testis
v. d. .....Vas deferens
x .....First atrial sphincter
I–V .....First to fifth body muscles

Plate X

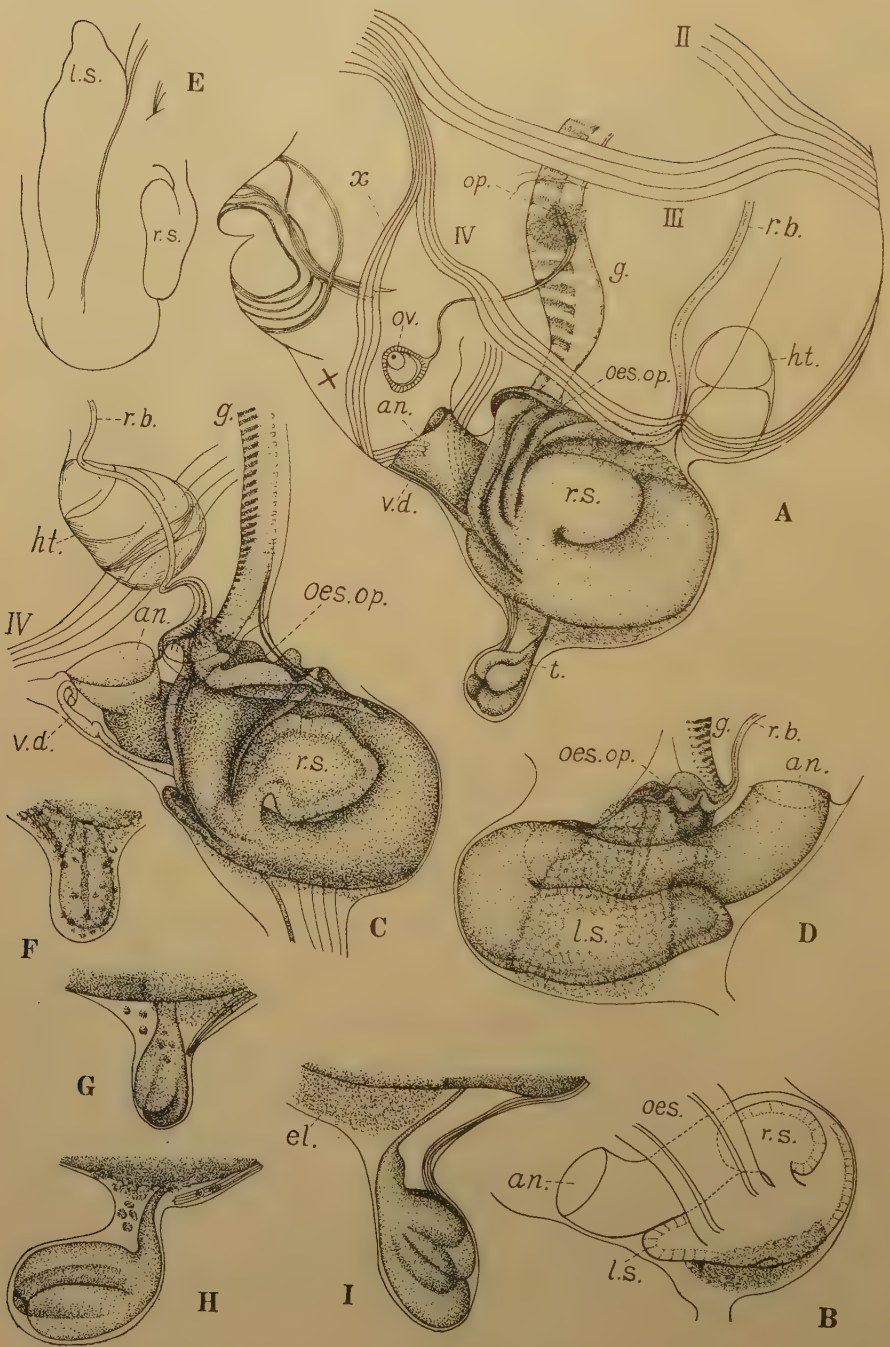
Brooksia rostrata (Traustedt), aggregated form.

A...Posterior part of a dextral individual, right side, ×110.
B...Nucleus of the same individual located obliquely to show both right and left blind sacs, ×110.
C...Nucleus and adjacent region of a sinistral individual, left side, ×50.
D...Nucleus of the same individual, right side, ×50.
E...Nucleus of the same individual, from posterior side, ×50.
F...Testis with a single follicle, ×200.
G...Testis with two follicles, ×200.
H...Testis with three follicles, ×200.
I ...Testis with four follicles, ×200.

an.....Anus
el. .....Eleoblast
g. .....Gill
ht. .....Heart
l. s.....Left blind sac
oes.....Oesophagus
oes. op. ...Oesophageal opening
op. .....Opening of oviduct
ov. .....Ovary
r. b. ...Retropharyngeal band
r. s.....Right blind sac
t.....Testis
v. d. ...Vas deferens
x.....First atrial sphincter
II–IV ...Second to fourth body muscles
× .....Original situation of ovary



T. Tokioka: Aggregated Form of *Brooksia rostrata*.



T. Tokioka: Aggregated Form of *Brooksia rostrata*.

RECORD OF WORKS

DONE AT THE SETO MARINE BIOLOGICAL LABORATORY

1953（昭和28年）

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No. (Jap. No.)

BABA, Kikutaro〔馬場菊太郎〕: Three new species and two new records of the genus *Glossodoris* from Japan. *Publ. Seto Mar. Biol. Lab.*, 3 (2), pp. 205–211. ..... **218**

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